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AGRICULTURAL ENGINEERING

THE JOURNAL OF THE
AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

Agricultural Engineering Exemplified

WITHIN our own profession we know what agricultural engineering is and does, but there may be occasions for the setting up of a specific example which shall be vivid, typical, symbolic. Such we have in the researches into soil dynamics being conducted at several of the land grant colleges and experiment stations, notably at Alabama. The subject matter distinguishes it sharply from any other branch of engineering, and the manner and purpose of study set it apart from any other aspect of agriculture. As research it meets the most exacting definition; at the same time its practical value is apparent even to the layman. Though this work were suspended today and all other achievement of the profession swept away, soil dynamics would remain an indisputable monument to agricultural engineering.

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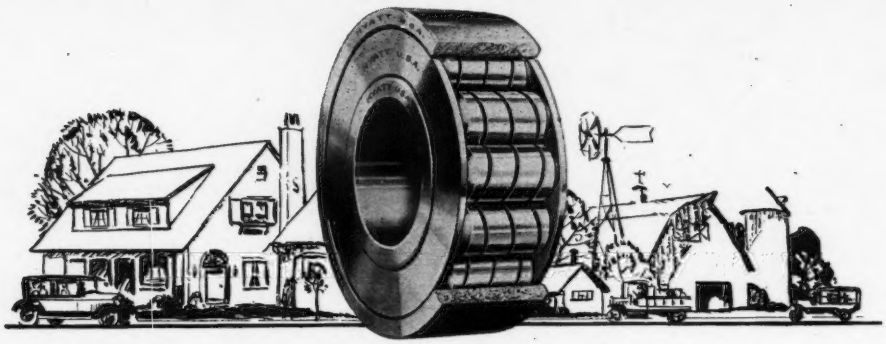

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AGRICULTURAL ENGINEERING

The Journal of Engineering as Applied to Agriculture

Vol. 8 JANUARY, 1927 No. 1

"Combine" and Tractor Feature Farm Machinery Meeting

Reported by Walter B. Jones

IN MANY respects the annual meeting of the Farm Power and Machinery Division of the American Society of Agricultural Engineers, held December 1 and 2 at the Hotel Sherman, Chicago, Illinois, may be appraised as the most successful ever held in Chicago, either by the Division or the Society as a whole. The exact attendance is not known, owing to a considerable number who failed to register, but these persons, by a conservative estimate, were sufficient to bring the total number to two hundred or more, vieing for honors in this respect with some of the annual meetings.

It so happened that the greater part of the program was of high popular as well as professional interest, which probably had something to do with the fact that the interest was so well sustained that there were few arrivals after the sessions started and still fewer early departures. The chairman of the Division, George W. Iverson, presided at all sessions, although for the corn borer discussion he asked G. W. McCuen of Ohio State University to assume the duties of the chair.

The combined harvester-thresher, or "combine," was easily the big feature of the meeting, partly because one-half of the total time available had been assigned to the subject and of the long list of speakers scheduled practically every one came well supplied with ammunition. In addition to this the combine figured rather prominently in the address by Mr. Campbell on the second day, and throughout the discussion this new machine, considered as being on probation in most territories, gave a rather unexpectedly good account of itself both under the critical eyes of the engineers and in the estimation of its farmer owners.

Owing to the absence of B. R. Benjamin the general-purpose tractor did not receive the amount of attention which had been planned, at least as regards development and design, but this style of tractor figured prominently from the viewpoint of utilization technique in the papers by Messrs. McCuen and Josephson.

The Spread of the Combine. Starting off the program on the morning of December 1, Past-President F. A. Wirt, advertising manager of the J. I. Case Threshing Machine Company, and previously connected in engineering capacities with various factors in the farm equipment industry, presented a paper on "The Spread of the Combine." He related the story of the combine's general acceptance for some years as the ideal method of harvesting winter wheat, then told how in 1924 it was introduced into Illinois for harvesting soybeans, this marking the beginning of a general invasion of the corn belt and other territories for harvesting a variety of crops other than winter wheat and in territories supposedly not adapted to combine operation—that is, outside the semi-arid regions.

Mr. Wirt cited figures showing very substantial savings in labor arising from the combine method of harvesting and other lesser advantages such as saving of additional grain and prompter marketing. An important point, humanly speaking, is that the combine has done away with that horror of harvest which has been the nightmare of farm women throughout the small grain areas. The whole thing was summed up in the statement that "just the cooking alone for the header and thresher crews takes as much labor as to do the entire job with a combine."

Forecasting the points which were brought out later by the college engineers, he said that the difficulties to be reckoned with are weeds, moisture in the threshed grain, and the weather hazard—rain, hail and wind—to which the standing grain may be subjected while waiting the additional time necessary before it is fit for combine harvesting. He pointed out that in the use of the combine the critical year is the first year, because farmers are very likely to get nervous and cut too soon.

The combine has not made the same progress in the spring wheat areas as in the winter areas, largely due to the greater amount of weeds encountered in the spring wheat. To use the combine method with the greatest success the grain should have non-shattering characteristics and stiff-growing stalks, both characteristics being retained until the grain is fully ripe and dry enough for storage. These points offer an excellent opportunity for the plant breeders to contribute their share towards the efficiency of farm production.

Admittedly, when grain is subject to lodging this takes place to a greater extent when cutting is postponed until fit for combine operations, but this difficulty is largely offset by the fact that the combine picks up lodged grain to better advantage than a header or binder—or at any rate the total crop saved with a given degree of lodging is greater with the combine.

In Mr. Wirt's opinion the windrow method of combining probably will not be practiced to any great extent in areas where the yield of straw and grain is high. He believes that the driving of combines by power take-off from the tractor is entirely feasible on reasonably level land. He stated as his judgment that the investment in a 16-foot combine is justified, in competition with other methods of harvesting, on grain acreages of 160 acres and more.

U.S.D.A. Combine Investigations. Next came a paper by C. D. Kinsman, agricultural engineer, U. S. Department of Agriculture, on "Results of U.S.D.A. Investigations of Harvesting with the Combine." Inasmuch as the government program of investigations is very comprehensive and will occupy at least a period of four or five years, Mr. Kinsman's remarks were in the nature of a preliminary or progress report. One important point which he brought out is that rainfall during the harvest season is not necessarily a limitation in the use of the combine, but it may necessitate the provision and use of means for drying the threshed grain. In addition, as brought out by other speakers, there may be other limitations.

It would appear from such cost records as have been collected that sixty acres is the lowest area on which the combine can compete with the binder, the total cost of putting the grain in the wagon box being the same for both methods on this acreage. As the acreage increases the economy of the combine becomes more and more apparent and at 400 acres the cost is only two-fifths that of using binder and thresher. It appears that the annual practical capacity of the combine is about forty acres for each foot in width of cut.

Investigation shows that harvesting with the combine involves a delay of about ten days past the time when cutting can be done with a binder, or five and one-half days after a header. But it appears from the statistics so far gathered that the loss, or risk of loss, from this amount of additional standing is not nearly so great as has been thought.

As to quality of work done the government engineers found that in wheat the combine carried over less grain than the thresher. In other crops the combine did not make so good a showing, due apparently to the fact that the machines are sent out adjusted for wheat and the operators have not made the necessary changes for the other grains. For example, the proper handling of grain sorghums requires the use of special sprockets on the cylinder shaft, furnished by the manufacturers for this purpose. It was found that these hardly ever were secured and in some cases dealers denied that such sprockets were available until they were pointed out in the repair list.

Grain Cleaning Tests. Robert H. Black, engineer in charge of grain cleaning investigations for the U. S. Department of Agriculture, who has for several years been studying and experimenting with the removal of dockage at the thresher, and whose progress report has been an annual occurrence at meetings of the Society, made a brief report consisting largely of moving pictures showing apparatus in operation. One feature of the current year's work was the construction and trial of a special grain thresher into which the disk style of dockage separator was incorporated as an integral part of the machine, instead of being used as an attachment or separate device as in previous years.

The other new and promising thing reported is a wholly new application of what may be called the pocket principle of these cleaners. In this case the pockets are indented in the surface of a wide rubber belt which operates at an angle of about forty-five degrees instead of being located in the sides of flat disks revolving in a vertical plane. Naturally, the shape of the pocket is different, but the belt separator offers considerable promise as regards low cost and light weight.

Symposium of Combine Investigations. In the symposium covering field tests and investigations of combine operation engineers representing the state agricultural colleges or universities of Wisconsin, Illinois, Pennsylvania, Ohio, North Dakota, Indiana, Saskatchewan, and Alberta were present. Space will not permit quoting from their reports to any extent, and in fact, with that efficiency characteristic of the engineer, the successive speakers abridged their reports by omitting what had been brought out by those preceding, and dealing only with findings which varied with climatic or crop conditions, etc.

In addition to the wheat, oats, barley and rye usually thought of as the legitimate provender of the combine, R. C. Miller of North Dakota mentioned the satisfactory use of combines in sweet clover, alfalfa, and speltz. Buckwheat however, does not behave well in the combine due to the extreme unevenness of ripening and the large amount of green material to contend with. The combine does splendid work in flax after frost has been permitted to kill the weeds and thereby eliminate green material. The Russian thistle offers considerable difficulty due to the way in which it raises the moisture content of the threshed grain. In North Dakota the combine is opposed by the elevator men but the owners of the twenty-five or so machines, most of them in the semi-arid regions of the state, are highly enthusiastic over it. In this state under ideal conditions the combined grain has about fourteen per cent moisture, which is just about safe and no more. Owing to the refusal of combined grain by the elevators and the moisture in some cases running over the prescribed limit these farmers had to store their grain and there was a little trouble with keeping in the bin, indicating that drying is a problem in this state.

In the course of a complete report E. A. Hardy, Saskatchewan, cited numerous reports of combines which had paid for themselves in one season, chiefly in labor saved, the number of men employed being the same and sometimes even less than the ordinary summer force. In general the grain has been of equal grade as that produced in the binder and thresher method. An interesting point had to do with the green kernels mixed in with the ripe grain due to cutting right through low, green spots instead of going around them. Although these green kernels are very conspicuous when first threshed, most of them ripen in a day or two, and if the total amount of moisture introduced is not too great are not objectionable. The ravages of the sawfly constitute a special problem in that province and may necessitate harvesting methods to which the combine cannot well conform—that is, as a straight combine and not taking into account the possibility of the windrow method.

Reporting for Ohio, G. W. McCuen pointed out the interesting circumstance that during the combine season there is less rainfall in Ohio than at Concordia, Kansas. As in other states, the losses by the combine method were found to be materially lower than by older methods, and the apparent yield of grain about two bushels an acre higher. He reported farmers baling straw from the combine by picking it up in the field with a buck rake, doing the complete baling operation at lower cost than from the stack. The farmers in Ohio have begun buying combines in spite of the fact that the university men have had to withhold specific recommendations due to the inadequate experience on which to base judgment.

An interesting point brought out by R. H. Wileman of Indiana had to do with a comparison of the grain threshed at the same time and place by combine and thresher respectively. That turned out by the combine tested eleven per cent moisture and graded No. 1, while that from the thresher showed fourteen per cent moisture and graded No. 3. Incidentally, similar results were reported from tests in Illinois. The combine has not yet made much headway in Indiana, having been introduced lately to handle soybeans, for which, as in Illinois and other states, it is the most satisfactory method of harvest thus far tried.

F. W. Duffee, reporting for Wisconsin, did not read his paper nor dwell on any of the points brought out by speakers from other states, but mentioned the need for special ventilation or drying of combined grain, at least in some cases. He told how at the Wisconsin university farm there was a quan-

The adaptation of the combine to soybeans has called for certain special features or adjustments. Even without them it affords the most efficient means of soybean harvest, both as to amount and quality of beans saved and operating cost

tity of seed barley from a highly valuable new variety which contained too much moisture to keep, according to accepted standards. It was stored five feet deep in a bin with a bottom of ordinary window screening supported on closely spaced slats, these in turn being supported on suitable joists and beams. The space under this screened floor was tightly enclosed and into it was turned the blast from a centrifugal fan somewhat similar to a wind stacker. Blowing was done in short periods at intervals, and, although the moisture content of the grain was not reduced so much as might be expected or considered desirable, the method was completely successful in preventing heating and in keeping the barley in fine shape for seed, at a cost of one and one-half cents a bushel.

A little later William Aitkenhead, professor of agricultural engineering at Purdue University, described a method of drying grain in the stack which he devised to prevent weather damage to a crop of soybeans. A frame of poles was set up in a sort of cone, like those of a tepee, and the soybeans were stacked around them to a uniform thickness and density. A pipe brought into the center of the open space in the stack through an underground trench brought the blast from a suitable fan. The air was heated by mixing with it the products of combustion from a fuel oil burner in such proportion as to give the desired blast temperature. A large air cleaner in the pipe line prevented sparks being carried into the stack. This arrangement worked well also with alfalfa. Operating cost was about 60 cents a ton.

In Illinois, according to I. P. Blauser, the apprehension as to trouble from moisture in threshed grain is unfounded. In this state the combine was brought in to tackle the problem of harvesting soybeans, and its use was extended to other crops. In soybeans the tests indicate that it operates with an average total loss of eight per cent, while with other methods which have been employed the losses run as high as 45 per cent at times. Beans threshed by the combine method show a lower moisture content than those harvested otherwise. Some difficulty arose where bull nettles were encountered, and under these conditions the bar type of cylinder seemed to be more satisfactory, as it crushes the nettles less. The best result has been secured where the cutter bar of the combine is especially arranged to operate within four inches of the ground, and the beans are picked up better when the reel runs faster than usual in relation to the forward travel of the machine so that, so to speak, the beans are swept back onto the platform.

The Illinois investigations indicated that the combine is the best method yet tried for harvesting sweet clover seed, in spite of the fact that the loss is estimated at ten per cent or more and the further fact that the bushy nature of the sweet clover tops necessitates an extra man with a broom or some such weapon to pat the material down and assist its entrance between the elevator canvasses. In the Illinois work the combines fitted with their own engines gave a somewhat better account of themselves due to the fact that, when choking or clogging is threatened, the forward movement of the outfit can be stopped without interrupting the steady operation of the combine mechanism, but is was remarked by Mr. Blauser that the same advantage could be secured with the power take-off drive if the latter took power from the engine through an independent clutch.

In Illinois the combine has been used for harvesting alsike and perhaps other varieties of clover with satisfaction. The clover preferably is cut with a mower equipped with a windrow attachment, or in any manner which leaves the material in a suitable windrow, and after curing is picked up and delivered to the combine platform by a hayloader, as in the Campbell method. This is desirable because of the large amount of green material in clover at the proper stage for cutting, and the necessity for thorough curing before effective seed saving is possible. Accurate data as to the percentage of seed recovered was not obtained but it is the guess of observers that it compares favorably with other methods.

The report of J. M. Smith of Alberta paralleled so closely that of Mr. Hardy that it was not presented in detail.

W. F. MacGregor, superintendent of the experimental department of the J. I. Case Threshing Machine Company, was the last of the scheduled speakers in this symposium to appear, and he took occasion to urge a high degree of conservatism in the introduction of the combine, both as regards its adaptation to field conditions and the aptitude of the individual purchaser in managing so elaborate a machine, pointing out the early exploitation of the small tractor as an example of how the thing should not be done. In this position he was supported both by other executives of the industry and by some of the college men.

Corn Borer Control Work. The matter of corn borer control was given attention, although not scheduled on the program. L. H. Worthley, of the U. S. Department of Agriculture, in charge of corn borer control, outlined latest developments in the situation and was followed by C. O. Reed and G. W. McCuen of Ohio State University, who reported progress from the engineering angle since the time of the former's comprehensive report at the annual meeting of the Society in June, 1926. It appears that the low-cutting attachments for corn binders were on the market during the 1926 season and sold freely in the infested areas. The commercial machines have encountered some difficulties under the very bad conditions this season, such as a tendency to pull the stalks due to too low an operating speed, insufficient clearance, failure to cut so low as should be, and inadequacy of bullwheel traction in one type. For the most part these are the same difficulties encountered with the experimental models worked out by the Ohio State University department of agricultural engineering.

A notable achievement in farm machinery development is the designing and building of a combination corn picker-husker and stalk shredder along the lines originally proposed by a farmer, O. D. Long, and elaborated on paper by the Ohio engineers. The concrete development was undertaken by Deere & Company and progressed from the drafting board to the field in ninety days. It is now at Ohio State University for testing. It is believed that this machine has usefulness which will assure it of a market, borer or no borer. Mr. Reed also spoke informally regarding the corn borer control program which has been mapped out on a large scale, describing it as admittedly an experiment, since there never has been previously either occasion or opportunity for attempting the same thing, but pointing out that the treasure at stake, our whole corn industry, is so great that no effort or expense should be spared in the attempt to solve the problem according to the dictates of the best engineering and entomological judgment.

Motorization of Corn Production. The subject of "Latest Developments in the Motorization of Corn Production," was reviewed by G. W. McCuen and the work being done in this direction at Ohio State University. The point was made that the motor cultivator is the keystone of the corn production arch. A four-row planter and four-row cultivator were used with excellent satisfaction. It was found that with a planter of this width there was some wire travel at the end of the rows, but although it necessitated slower travel with the cultivator when crossing the rows, it did not prevent good work.

In these studies attention was given to the reduction of nonproductive time in corn work. It was found that tractor chores, principally lubrication, consumed about 9.5 per cent of the time when ordinary lubricating equipment was used, and that this was reduced to 3.9 per cent when the machine was equipped with lubricating fittings of the contact type used in connection with a suitable high-pressure gun. Quick steering and short turning are important in relation to the time consumed in turning at the ends of the rows. In connection with power from the motor cultivator, early cultivation with the peg-tooth harrow and with the rotary hoe takes on additional advantages and effectiveness.

A brief discussion of a similar line of work at the University of Nebraska, prepared by E. E. Brackett, was read by C. W. Smith.

Discussing this subject, J. B. Davidson, of Iowa State College, described the method employed by J. Leo Ahart, Dow City, Iowa, who handles his soil preparation and early cultivation in such a way that the corn needs only one cultivation in the ordinary fashion.

The Power Take-Off. Under the subject, "The Power Take-Off Up to Date," F. N. G. Kranich, manager of the tractor

and implement department of the Timken Roller Bearing Company, stated that there had been little actual engineering progress since his previous paper on the same subject, and pointed out that further progress is being held up until the manufacturers of tractors and of driven machines get together in a program of agreement regarding standards for sizes, forms, and positions of mating parts, in which connection he made certain specific suggestions for the consideration of the committee which was to take up the problem immediately. He suggested that there should be two sizes of power take-off shafts, one to be 1⅛ inches in diameter, suitable for motor cultivators and tractors in the two-plow class, and a larger size 1⅜ inches in diameter for use on larger tractors transmitting considerable amounts of power to combines or other machines of similar power requirements.

Campbell on Super-Farming. Foremost from the standpoint of popular appeal, at least, and full of inspiration for agricultural engineers was the talk by Thomas D. Campbell, president of the Campbell Farming Corporation, Hardin, Montana, entitled "Manufacturing Wheat on a 100,000 Acre Farm Factory." Much of Mr. Campbell's talk was given simultaneously with the showing of 3,000 feet of moving pictures whereby the seemingly incredible methods and achievements of this super-farmer were presented clearly and vividly to the spectators. There were processions of a dozen or more 30-60 tractors pulling corresponding numbers of plows along a single land; tracklaying tractors pulling trains of a dozen wagons, each loaded with 200 bushels of wheat, out of the fields and away to the elevator; and views taken during the world's record of 4,321 bushels of wheat threshed in a 14-hour day, using a steam engine of greater capacity than any of the tractors available and an all-steel thresher which had previously run out more than three-quarters of a million bushels of grain. There were eight men pitching into the feeder all day, keeping it filled without interruption as full as consistent with proper threshing. The uninterrupted stream—a fat stream—of straw from the blower showed not only the speed but the nicety with which the work was being done, and the automatic weigher had little time for rest between dumps.

The method of harvesting formerly employed on the Campbell properties, consisting of large tractors pulling a train of binders with a man on each binder, was shown by way of contrast with the method now adopted as standard, namely, cutting the grain from a 40-foot swath with a unit consisting of a tractor and four 10-foot binders with the binding heads removed and the last three provided with conveyors of increasing length so as to deliver all the cut material into a single windrow, all four binders being attended by a single operator. Later came the tractor-drawn combine with the platform raised and a hayloader hitched behind so as to pick up the windrow and deliver it to the platform, whence it was carried to the cylinder and threshed in the usual manner.

Mr. Campbell took pains to emphasize that this method of harvesting is not limited to mammoth enterprises such as his own, but for smaller farms suggests the use of perhaps three eight-foot binders with conveyors, followed by a 16-foot combine. The rate of travel of the combine should be fast or slow according to the amount of material to be handled. He also advised that the hayloader should be eight feet in width to avoid skipping any material when the swath is scattered somewhat by wind or other wise, and he also pointed out that losses will occur unless the hayloader is provided with a second or gleaning cylinder.

Mr. Campbell does not advocate or practice the windrow method of combining when conditions are favorable for straight combining from the standing stalk in the usual manner. He does contend that with the windrow system as an optional method for use when conditions are not favorable to straight combining every important objection or handicap to the combine is wiped out. In this connection he referred to the difficulties mentioned in the symposium the day before, namely, grain not dry enough to go into the bin, green or weedy material, and weather hazards, including lodging. In general, Mr. Campbell believes that with or without windrowing the combine is the practical and economical method of harvesting all kinds of grain, including flax, soybeans, alfalfa, sweet clover, etc., under practically all conditions of climate and soil and on farms of all sizes except the very smallest. The change from windrowing to straight combining is chiefly a matter of uncoupling the hayloader and dropping the cutter bar.

The paper on "Recent Development in the General Purpose Tractor" scheduled for presentation by B. R. Benjamin, experimental engineer of the International Harvester Company, was omitted due to the author's absence from the city, but a motion picture showing the latest form of the Farmall tractor, with which Mr. Benjamin's work has had to do, was shown, portraying the machines in a wide variety of farm operations, and illustrating a number of the special, large-capacity cultivating and other attachments which have been developed for use with it.

Tractor Lug Research at Alabama. The paper, entitled "Field Tractor Lug Studies," by John W. Randolph, associate professor of agricultural engineering, Alabama Polytechnic Institute, was too technical to permit abstracting briefly, but it may be stated that the experiments were conducted in the field on Norfolk sand, a soil which has been characterized by tractor experts who have tried to make their machines work in it as "ball-bearing sand." These studies, following elaborate experiments in the laboratory and a great deal of mathematical analysis, have resulted in the establishment of the principles of traction in such soils and the development of a mathematical formula whereby the performance of a tractor wheel of specified loading, dimensions, and lug equipment can be predicted with a high degree of accuracy. A practical example of the importance of this research is found in the fact that by the application of these principles the available drawbar horsepower of a tractor has been increased 150 per cent over that obtainable with standard equipment—that is, the drawbar capacity was multiplied by two and one-half—and the tractor enabled to develop its rated power on the extremely poor footing of the Norfolk sand.

Possibilities in Tractor Research. The paper by J. B. Davidson, professor of agricultural engineering, Iowa State College, on "Possibilities in Tractor Research," might properly be described as visionary—not the wild dreams with which the term ordinarily is associated, but the well-directed vision to the future whereby research effort is given profitable guidance, and springing from a wealth of experience correlated under the discipline of an engineering mind. One important point brought out was the marked reduction in power costs which can be attained by spreading the fixed overhead expenses of tractor ownership over a greater amount of use per year, it being apparent that with an entirely reasonable increase in application the cost of tractor power at present may be reduced fully one half.

Prof. Davidson called attention to the heat values and comparative costs of the various kinds of fuel used or at all likely to be used as sources of farm power. Pointing out that the cheapest power does not necessarily come from the cheapest form of heat energy, he showed that at typical present prices coal is by far the cheapest source of heat, giving something like two and one-half times as much for one cent as its nearest competitor, kerosene. Corn and hay give about two-thirds as much as kerosene, and gasoline about one-half as much. Alcohol, although prohibitive at present prices, is deemed worthy of serious attention, while furfural, now produced at high cost and in small quantities chiefly from oat hulls is capable of being produced from a large variety of cellulose-bearing farm wastes or byproducts. It merits consideration, however, because of the large amount of raw material obtainable, the possibility that it may ultimately be produced at costs which will compete with other fuels, and the further promise it has of being valuable as an anti-knock material. The low cost of coal undoubtedly accounts for the European experiments with producer gas plants for trucks and tractors.

It was pointed out that while the thermal efficiency of the internal-combustion engine as used in the tractor is much higher than in motor cars it still is far below the best stationary practice and offers room for substantial improvement, perhaps along the line of constant compression engines.

Another great opportunity for research is in finding ways and means to improve the efficiency with which the power

developed by the engine is applied to actual tillage or other work. Prof. Davidson described as a mental shock the finding that rolling resistance of the tractor wheel is the greatest single offender in stealing engine power in drawbar work, accounting, together with slippage, for 30 to 60 per cent of the total power developed by the engine under practical field conditions. This leads to the question as to whether the present practice of running a tractor back and forth over soft ground is the best method of accomplishing field work, or whether we are neglecting fundamental processes and merely using a mechanical substitute for the horse. The possibility of reducing draft work to a minimum seems to promise research opportunities.

Referring to his service with the U. S. Department of Agriculture as director of the survey of research in mechanical farm equipment, he states that among all the agricultural experiment stations there are ten states which are carrying on fourteen tractor projects.

H. B. Josephson, research engineer at Pennsylvania State College, presented a paper, illustrated with slides, dealing with investigations of the technical and economic adaptability of the general-purpose tractor to Pennsylvania conditions, involving farms of small acreage, more or less rough topography, a wide diversity in crops, and stony soils. This investigation was handicapped by abnormally unfavorable weather conditions and Mr. Josephson remarked that since the study accomplished only about half what had been intended, he probably could make his report in half of the time assigned for it.

THE S.A.E. TRACTOR PROGRAM

ON DECEMBER 3, following the A.S.A.E. Farm Power and Machinery Division meeting, the Society of Automotive Engineers held a tractor meeting at which attention was devoted to engine fuels, the relation between engineering and automotive materials, industrial applications of the tractor and highway building equipment.

Dr. Gustav Egloff, director of research, Universal Oil Products Company, discussed future probabilities as to demand for and supplies of liquid fuel for internal-combustion engines, concerning alike the automotive and power-farming industries. Based on the present rate of fuel consumption per vehicle, Dr. Egloff expects the demand at some time in the future to reach 150 billion gallons a year compared with the present production of some 14 billion gallons of gasoline. This present production and consumption of gasoline comes from approximately one billion barrels of crude oil, part by normal distillation and part by cracking processes. In the opinion of the speaker, if all of the crude were treated by suitable cracking processes the amount of motor fuel would be doubled. It is with this cracking or thermal decomposition of petroleum oil, and in fact all hydrocarbons, that Dr. Egloff has concerned himself, and to the commercial application of which he has contributed numerous improvements in cracking and refining processes.

So far as basic supplies of raw materials are concerned, Dr. Egloff believes that the much discussed shortage of internal-combustion engine fuel is at least several centuries away, notwithstanding the tenfold increase in consumption which he expects. He declares that there apparently is in South America a vast field of oil, while Roumania, Russia and Persia, in addition to their present large oil production, have vast quantities of potential oil in reserve. Added to these are the finding of oil in Africa, Canada, China and elsewhere which may be developed on a large scale whenever economically justified.

Nor are liquid engine fuel resources limited to petroleum. He mentioned by way of example the vast tar-sand deposits in Alberta, Canada, which when made to yield fuel by cracking processes are capable in themselves of supplying the world demand for engine fuel for more than a century. Then there are other resources such as wood tars, and the enormous deposits of oil shale, which latter are known to contain an abundant supply of fuel, though in the present state of the art the production of engine fuel from them cannot compete with the plenitude of petroleum which gushes from the earth.

Another important potential source of engine fuel is coal, of which the world has abundant reserves. In addition to the comparatively well-known liquid hydrocarbons resulting from the destructive distillation of coal, the discussion brought out information as to the hydrogenation of coal by Prof. Friedrich Bergius of Heidelberg, Germany. In this process the coal is rather finely ground, mixed with a heavy oil previously produced in the same process, forming a thick, pasty mass which is pumped together with hydrogen gas into a reaction chamber where, under pressure of about of 3000 pounds per square inch and a temperature of 840 degrees Fahrenheit, about five per cent by weight of the hydrogen is absorbed by the coal, resulting in the liquefaction of more than ninety per cent of the latter. About five per cent of the product appears as a gas, and there is some carbon and ash. The process is, however, accompanied by certain mechanical difficulties.

In the opinion of the speaker the motor fuel of the future probably will be a blend of normal fuel from petroleum and cracked products from some of the other sources mentioned. Most of the specifications now applying to motor gasoline will be abolished and the criteria will be chiefly anti-knock properties and ease of starting. The adoption of engines to take advantage of these properties and other natural developments in engine design will result in doubling the mileage per gallon.

It appears that the anti-knock properties of engine fuel are

(Continued on page 19)

The motorization of the corn crop is not alone a matter of row tillage. Always a part of producing corn as a shipping crop, shelling now takes on importance as a part of the corn borer control program

Mexico and the Agricultural Engineer

By Chas. F. Shaw

Mem. A.S.A.E. Professor of Soil Technology, University of California

IMMEDIATELY following the annual meeting of the American Society of Agricultural Engineers at Lake Tahoe, California, in June, 1926, I had the pleasure of spending a month in Mexico, conferring with the Mexican government regarding the organization of a department of agronomy and a soil survey and examining certain tracts that had been proposed for development under the new plans for irrigation. The Comision Nacional de Irrigacion has been organized by President Calles to direct this important work, with funds now available totalling over thirty million dollars. The Comision has engaged Walter E. Packard, an A.S.A.E. member, as "jefe del departmeto agronomico," or chief of the department of agronomy, and has just secured A. E. Kocher, formerly of the U.S.D.A. Bureau of Soils, as chief of the soil survey work. Already the work of Mr. Packard, in demonstrating the existence of dangerous amounts of alkali in the subsoils of a proposed project which was just about to be approved for development, has saved the government from losses that would run into hundreds of thousands of dollars.

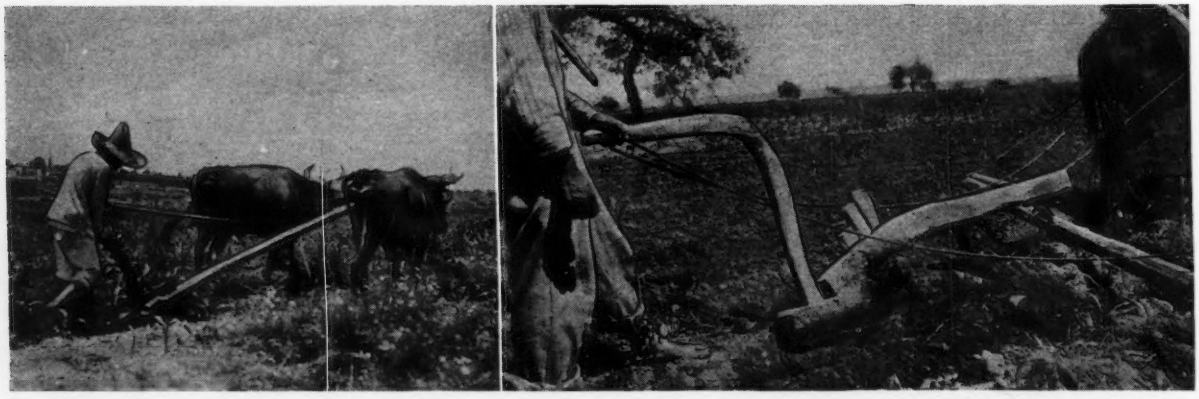
The members of the Comision are fully aware of the importance of expert advice and assistance on all technical questions and are making full use of the agricultural engineering assistance available. They are not only concerned with examinations of the soils of the projects and studies of their economic feasibility, but they are also studying the problems of placing families on the new farms to be developed, and of financing them in their start as economic units in a new agricultural community. This work calls for the farmstead engineer and the expert in land settlement methods, the organization of community enterprises, cooperative buying, selling and credit organizations and a host of other lines of work involved in establishing a new agriculture in an old country.

The rural population of Mexico now is, to say the least, backward. It was a shock to step so far back in the centuries in a day's journey below the Rio Grande. Primitive methods of life were anticipated, but not the wooden plow and the ox cart! From the standpoint of tools and equipments, the Mexican farmer of today is working in the time of Christ—nineteen hundred years behind his next door neighbor, the American farmer! It is no wonder that, with a land well suited to the production of corn and wheat, Mexico is importing over twelve million dollars worth of these grains from the United States, and over eight million dollars worth of pork and packing house products! With a population of only about fifteen millions, Mexico is nearly to population saturation, mainly because of the low production per capita.

This condition is not necessary and will not continue. The old time conservatives assert that the Mexican can not and will not use modern tools and modern methods. But I have seen these Mexicans in the fields of California, Arizona, New Mexico and Texas, effectively using and caring for all the modern equipment of the farm, including tractors. They can use these modern tools, and must use them if the developments the government is now inaugurating are to succeed and pay out.

The wooden plow shown in the illustrations accompanying this article will be supplanted by good steel plows, the brush drag by good harrows, and the machete by the mowing machine and grain binder or harvester. No man, however active and ambitious, can ever carry the costs of an irrigated farm if he must cut his wheat and his alfalfa by the handful with a knife!

Our farm implement makers have an opportunity in Mexico, an opportunity to be of service to that country and to make a profit for themselves. The Mexican farmer has little money —he will make progress slowly. He must be supplied with a simple and light plow and harrow at a low cost, with other tools of the same order, and as his earnings grow and his capabilities increase, he will be able to purchase heavier and more effective equipment. The irrigation development will not make a market for tractors or other heavy and expensive equipment. These lands will be subdivided into one family farms, and the equipment needed will be relatively light. But there will be much needed. In all the State of Aguascalientes, I did not see twenty iron or steel plows and not one real harrow or cultivator. But there were hundreds of wooden plows, used in breaking the ground or in cultivating the growing corn, beans and chili. At least 50,000 acres will be irrigated in this one project. There will be in the neighborhood of one thousand irrigated farms established and settled. There are a dozen or more other projects like this in other parts of the republic. Here is a great potential market at our very door, which, if developed, will not only benefit our manufacturers but be of great and lasting benefit to our neighbors.



(Right) The horse-drawn wooden plow has a short beam. The wedges in the beam permit the adjustment for depth and the pegs in the side provide the spread of the soil in lieu of a moldboard. The point was shod with a short piece of iron. The owner of this plow was very proud of his implement and was doing good work cultivating his corn.

(Left) The ox-drawn plow has a long pole beam;; otherwise it is the same as the horse-drawn implement. The yoke consists of a slightly curved stick which is lashed to the horns of the oxen. The speed is slow and the plowman with his ox-goad is a real "cow-puncher"

Automatic Control of Natural Draft Ventilation of Stables*

By J. L. Strahan

Mem. A.S.A.E. Head of Ventilation Department, Louden Machinery Company

OWING to the fact that variations in weather conditions, chiefly changes in temperature and in the direction and intensity of wind, have a pronounced effect on the operation of natural draft barn ventilating systems as heretofore made, it has been necessary for the barn attendant to make adjustments of control dampers both to regulate the intensity of air flow in the normal direction and to prevent backdrafting. This places upon manufacturers of such systems the double responsibility of designing and installing the physical equipment and the more difficult task of educating the operator in its proper uses. The last half of the job is difficult because the farmer already has his entire attention and energy absorbed in a complicated business, and, furthermore, because a men sufficiently well versed in the physical laws involved is not likely to be a barn hand. Even with difficulty from the human element overcome, there remains the difficulty of making manual adjustments required by sudden changes in atmospheric conditions which develop in the absence of the attendant.

The essential function of a ventilation system is to provide for a constant and properly regulated change of air, the rate of change depending upon the physiological needs of the animals, the amount of water vapor produced, and the temperature to be maintained. These factors controlling the desired rate of change must be correlated with the forces producing air movements in a natural draft system. These forces are, in the order of their importance, temperature difference, wind pressure, and difference in relative humidity.

The problem of the designer is to determine the volume of air required to meet the physiological needs of the animals and to remove moisture rapidly enough to prevent condensation on walls and ceiling; to discover the relation between this amount of air and the maintenance of a reasonable inside temperature; to determine the proper number and size of ducts, and to determine the location of these ducts to secure proper diffusion or circulation of air within the stable. In this connection attention is called to the importance of the building itself as a part of the ventilation system just as much as the ducts or cupolas, tightness of walls being necessary to limit air circulation to the ducts in order that it may be kept under complete control, also the reduction of heat losses by radiation through the walls to a point which will at the same time maintain the desired degree of comfort for the animals and afford a suitable temperature difference for operation of the ventilating system. The procedure then is to design a system which will give the desired rate of air change when draft producing forces are at a minimum, and then to apply means for counteracting the draft-producing forces as they increase in intensity.

Temperature difference and wind velocity are the dominating factors in the rate of air flow, humidity playing but a small part. As compared with a normal rate of flow at a temperature difference of 20 degrees Fahrenheit, assumed as the minimum temperature difference for which the barn will be closed up and reliance placed on the ventilating system, the air flow at a temperature difference of 60 degrees will be approximately twice that which is desired. There remains to be taken into account the influence of wind velocity, which may be at a maximum at the same time that the temperature difference is greatest. Although figures are not available to show the effect of varying wind velocities on flue velocities under working conditions, it is known that the effect is considerable, and it seems safe to guess that an uncontrolled system which operates efficiently under minimum draft conditions will furnish from two to three times the desired rate of air change when the draft-producing forces are at a maximum.

To give this control, dampers are fitted in the intakes, the outtakes, or both. While there are technical advantages in having damper control at both points, it frequently is found in practice that the attendant finds it easier to employ the outtake controls, and that once closed there is a tendency for the outtake dampers to be forgotten, thus blocking the operation of the ventilating system entirely. The effects are particularly bad when the intakes are provided with automatic backdraft controls, as these prevent what little circulation there might be by reverse flow through some of the intakes.

It is concluded by the author that, taking human nature into account, it is better to remove temptation by omitting dampers entirely from the outtake flues, and to make the latter so smooth on the inside "that the inevitable gunny sack will fall out." This transfers the entire burden of control to the intakes, for which purpose both manual and automatic control heretofore have been employed. Both because of the seriousness of loss of heat by backdrafting through the intakes, and also because backdrafting occurs spasmodically, hand control is not very satisfactory and attention was early directed to automatic means, the first attempt being by Prof. F. H. King's trapped intake, a device fairly successful in controlling backdrafting from heat pressure alone, but usually not adequate to offset the effect of winds strong enough to cause low pressure on the lee side of the building. The addition of hand control dampers on the inside end of

*Abstract of paper presented at the 20th annual meeting of the American Society of Agricultural Engineers, Lake Tahoe, Calif., June, 1926. The complete paper will be published in the 1926 Transactions of the Society.

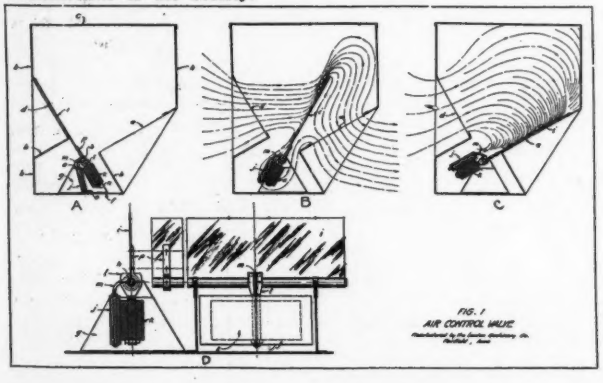


FIG. 1
AIR CONTROL VALVE

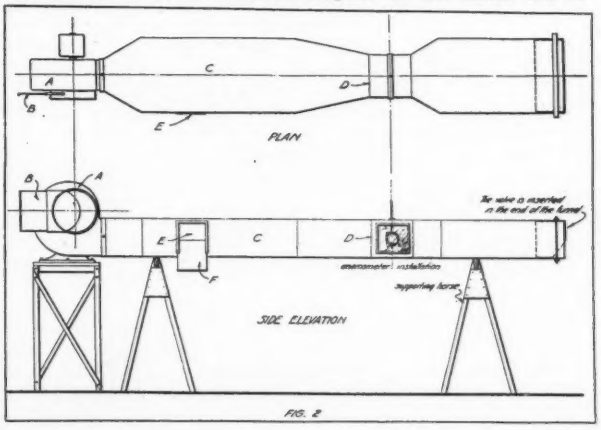


FIG. 2

the trapped intakes, to be closed entirely on the lee side during periods of high winds, gives very satisfactory results but unfortunately requires more constant and more intelligent attention than usually is available. This construction also is difficult to incorporate into modern fireproof buildings at reasonable cost.

During the past five or six years there have been put on the market devices to shut off the intake opening automatically as soon as backdrafting occurs. They consist of light weight vanes or dampers mounted horizontally or vertically in metal housings and not only avoid the difficulties arising through variations from wooden wall construction but also give a practical degree of success in backdraft control. They do, however, require a perceptible backdraft velocity to create a closing pressure, depending on the delicacy of their bearings and, in at least one case, on the accuracy of installation.

It is believed that the device here described, developed by the company with which the author is connected, is the first attempt to add to a backdraft control device the additional function of regulating the volume of air flow in the normal or proper direction, this latter function having heretofore been left entirely to hand dampers. The purpose of this device is to keep the volume of air flow automatically within a specified maximum regardless of wide variation in draft-producing conditions. It is believed that such a device may obviate 90 per cent of the attention required by the attendant, and that variations in temperature and humidity can be regulated within much narrower limits than is possible with a hand-control system.

Several cross sections of this device are shown in Fig. 1. Aside from the galvanized iron housing with its removable cover (c) the essential parts are the aluminum vane or damper (i), supported by suitable transverse shaft and bearings, the counterweight and the control weight (j). It will be noted that the damper has two closing positions, the one at (d) being the position to prevent backdrafting and that at (e) the fully closed position for preventing excessive flow in a normal direction. In (B) the damper occupies a position for air flow normal in both direction and volume.

The threaded stem on which counterweight (k) is mounted is rigidly attached to the vane in such fashion that the aluminum damper, the axis of its bearings, and the center of gravity of weight (k) are accurately in the same plane. In operation the position of weight (k) on its threaded stem is so adjusted that the center of gravity of the system is slightly above its axis; that is, the counterweight (k) does not quite balance the damper (i). In consequence the damper has a resting position as shown at A, with the duct closed against backdrafting, thereby enabling it to intercept backdrafting of very low velocity.

The control weight (j) is pivoted on the axis of the damper so that it hangs freely and exercises no influence on the position or movement of the damper when the latter is at or near the backdraft-checking position. But as the damper swings to the right, as shown in B, under the influence of air passing in the normal direction, weight (j) swings against weight (k) and becomes in effect an addition to it. With this additional counterbalancing it takes a considerable velocity of air to swing the damper to the closed position shown in C, the exact amount of this velocity and its pressure being subject to adjustment by raising or lowering weight (j) between the lock nuts (o) (o). In practical operation it is found that the closing pressure is quickly dissipated in the intake system, whereupon the damper reopens. Its operation, then, is not to shut off all ventilation, but to admit air in a series of puffs, the frequency and duration of these puffs varying with the intensity of the draft-producing forces so as to pass a substantially uniform average amount of air per minute.

In Fig. 2 is shown an apparatus for calibrating these automatic valves so that they will close under any given pressure. The blower (A), capable of delivering up to 850 cubic feet of air per minute, is controlled by the intake damper or throttle (B), and the bleeder or waste opening at (E). The rectangular galvanized steel tunnel (C) is constricted at the point (D) for the installation of an anemometer of the Birom type. The valve to be calibrated is inserted in the end of the tunnel.

In routine calibration the weights (j) and (k) are set in position indicated by experience to give approximately the desired results. The throttle (B) is closed until the air flow is reduced to a point which just permits the valve damper to remain open; then the waste opening (E) is slowly closed until the valve damper closes. The waste opening is then opened a trifle and the valve opened by hand. A few trials like this develop a critical pressure which is just insufficient to close the valve, and at this rate of air flow the anemometer is read with a stop watch and the reading reduced and corrected to give volume in cubic feet per minute. If this result does not conform to the calibration called for by the design of the system in which the valve is to be used, the control weight is raised or lowered as the case may demand, and the critical air flow at the new setting established by further testing. Anemometer readings on the same valve at different times but with the same setting ordinarily agree within two per cent.

Assuming as a premise that the ideal condition calls for a uniform rate of air flow with uniform temperature and humidity, regardless of outside conditions, it follows that the ideal solution is to maintain a uniform rate of air flow with auxiliary control of heat production and humidification, a procedure obviously too expensive and elaborate for acceptance by the trade at the present time. The practical present approach to this ideal is to assume heat production and humidification as constant factors and to control air flow between such extremes as will avoid harm to the animals and approach more closely to uniform temperature and humidity conditions than is possible with uncontrolled ventilation.

If uniformity of stable temperature be taken as an ideal there should be means for reducing the rate of air flow with decrease in temperature. This implies a thermostatically controlled valve mechanism, calibrated to give a flow-temperature curve in conformity with pre-determined desiderata. Such a device operating entirely on temperature variation would not take into account the effect of wind pressures, which forces ordinarily cause wider variation in intake velocities than temperature difference changes.

In consequence there is a question as to whether thermostatic control will in practice be as effective a means of minimizing inside temperature variation as will a device such as the one described, which operates as a function of air flow velocity in the ducts. Devices operating on the latter principle will absolutely set a limit on the volume of flow regardless of the cause of tendency to increased velocity, and that was the end sought in designing the device herein described.

A Report of Interest to Agricultural Engineers

THE agricultural engineering profession will be particularly interested in the recognition given to agricultural engineering and other features of the report on the agricultural experiment stations for 1925, which has just been issued by the Office of Experiment Stations of the U. S. Department of Agriculture. Considerable space is devoted to a discussion of the Purnell Act, including its administration, funds, etc.

Under the general heading, "Some Results of Recent Station Work," which occupies a large portion of the report, considerable space is devoted to outlining the progress made at the stations during the year, 1924 to 1925, in the development of investigation in agricultural engineering.

Another agricultural engineering contribution of considerable importance to the report is an article entitled "Station Work on the Mechanics of Tillage," by R. W. Trullinger, specialist in agricultural engineering.

A.E.S.C. Elects Officers

AT THE annual meeting of the American Engineering Standards Committee on December 9, Charles E. Skinner, a representative of the American Institute of Electrical Engineers, was re-elected chairman for the year 1927, and Charles Rufus Harte, representative of the American Electric Railway Association, was re-elected vice-chairman.

Farmhouse Kitchen Arrangement From the Standpoint of Household Management*

By Greta Gray

Research Specialist in Home Management, University of Nebraska

WHEN the average man and woman are looking for a dwelling, they usually desire something like the homes with which they are familiar. Their standards have been set for them by what is on their market, whether they live in tenements, suburban bungalows, or farmhouses. Their ideals may be vague or definite, but in either case they are generally unreasoned. They are satisfied with a place that measures up to their own untrained and uninspired conceptions of beauty, and they often have their hearts set on a breakfast nook or some other detail without regard to its relation to the whole house. A built-in ironing board may turn the scale of their choice notwithstanding some seriously adverse factor which they do not understand. The average man and woman lack discrimination in choosing their dwelling because they have not the basis for aesthetic judgment; they can not decide a question of sound economical construction, and they do not analyze their needs sufficiently to recognize all the factors of convenience.

The artist, working with line, mass, texture, and color composes a beautiful building; and the engineer, concerning himself with the strength of structures, the mechanisms for water supply, and so forth, creates a safe one. The household management specialist, thinking of arrangement and furnishing as they affect housework and living, plans a convenient one. It is the duty of the architect to combine the viewpoints of the artist, the engineer, and the household management specialist in order to educate the average man and woman to better standards. It is his duty not only to satisfy but to improve their artistic ideals, and to fill not only their felt needs, but their unsensed ones as well. If he does not have experts in design, engineering, and arrangement to consult, he himself should master each of these divisions of his art. Unfortunately, however, although many architects do succeed in uniting the viewpoints of the artist and the engineer, very few of them can include the viewpoint of the specialist in home management who has analyzed household work and home activities.

A speaker at the National Farm Homes Conference, sponsored by the American Society of Agricultural Engineers, suggested that architects, as part of their training, do housework for one month. But even if the average architect had this experience, he, like the average housewife, would fail to make a critical examination of housework and of the home as a workshop. At best he would learn the problems of only one household at only one season. The women who prize homemaking and who know housework and study it from the angle of scientific management, whether they are housekeepers or research workers, have a big contribution to make to home improvement, but architects, builders, and manufacturers have yet to seek their help and to carry out their suggestions.

Research in arrangement has been somewhat limited, but enough of it has been done to show that the average home can be greatly bettered in regard to comfort and convenience. It would take too long to dwell upon even a few of the adjustments that have been found to be desirable, so the arrangement of the kitchen from the standpoint of labor saving will be the only one discussed in this paper, although the details of arrangement in other parts of the house are of no less importance. The emphasis of the discussion will be placed upon the disposition of the equipment used in serving meals and in clearing away after them, but the location of the kitchen in relation to the rest of the house is of equal consequence, and the situation of the stove in regard to the fuel supply, and the positions of the refrigerator and the doors and windows must have the architect's close attention, if the housewife is to have all the convenience that is possible.

Labor saving in kitchen planning means step saving. Few people realize the amount of walking that one may be obliged to do in the preparation of three meals a day in a poorly arranged kitchen, and few know how greatly the amount can be reduced by the proper disposal of equipment. But one woman, who had an inquiring mind, found, by the use of a pedometer, that she walked six miles a day in doing all of her housework. When she rearranged her kitchen, she had only to walk four miles. Moreover, in the practice house of one of our state colleges, it was found that just in the preparation of meals, without any dishwashing, the cook walked from one and a half to two miles a day in a well-arranged kitchen.

The first rule of kitchen convenience is that the equipment for food preparation and dishwashing be apart from that used for all other activities. It is best to provide else-

*Paper presented at the 20th annual meeting of the American Society of Agricultural Engineers, at Lake Tahoe, Calif., June, 1926.

"The artist, working with line, mass, texture, and color, composes a beautiful building; and the engineer, concerning himself with the strength of structures, the mechanisms for water supply, etc., creates a safe one. The household management specialist, thinking of arrangement and furnishing as they affect housework and living, plans a convenient one. It is the duty of the architect to combine the viewpoints of the artist, the engineer, and the household management specialist."

where for outside tasks that are sometimes performed in the kitchen. If the kitchen must also be dining room, it is more convenient and more pleasant to have the dining table at one end of the room with the kitchen furnishings at the other than it is to have the table in the center with the furnishings around it. It should be noted, however, that with a proper arrangement of equipment in a kitchen of the right size, meals can be served in an adjoining room with as little work as is required to serve them in the kitchen.

The work of meal serving includes the preparation of raw food, cooking, serving, clearing away, and dishwashing. As fruits and vegetables are made ready at the sink, and bread, pastry, and other foods at the work table, the preparation of raw food requires many steps between the sink, the work table, and the stove; hence these furnishings should be placed close together. In like manner, serving, clearing away, and dishwashing call for a good many steps between the dining table and the stove, the dish closet, and the sink. Hot food is taken from the stove to the table, so the stove should be near the dining room door. Dishes must be carried from the table to the sink and put away in the closet, so these parts of the equipment should not only be near the dining room, but close to each other as well. Moreover, as the natural and easy way for the work of stacking, washing, drying, and putting away of dishes is from right to left for the right-handed person, there should be a space at the right of the sink for stacking, and a drainboard at the left, with a dish closet next to the drainboard, or just above it. The dining room door ought to be immediately to the left of the dish closet, so that the dining table can be set with the fewest steps, and so that one person can get out the dishes and set the table without interfering with a second person working in the kitchen. If the dish closet is a two-way one, however, with doors into both kitchen and dining room, the dining room door may be in a different position, and the arrangement will be even better because kitchen and dining room work will be entirely separated, and a convenient serving center will connect the two rooms.

Good kitchen arrangement may be obtained by placing the dining room door, the sink, and the serving center, from right to left along the dining room wall, with the stove at right angles to the serving center; or it may be obtained by placing the door, the stove, and the serving center, from left to right along the wall, with the sink at right angles to the serving center. The positions of the furnishings may be varied, but they can not be reversed and remain good for the right handed person. Plans and pictures, which make the features of arrangement clear, can be found in the two bulletins called "Convenient Kitchens" and "The Convenient House," which are to be published by the Bureau of Home Economics of the United States Department of Agriculture.

A well-designed room, of 90 to 95 square feet can accommodate all of the necessary kitchen equipment in full size and one that has only from 70 to 75 square feet can accommodate it in small size, yet there are many kitchens with more than 150 square feet which are so cut up by doors and windows that they can not accommodate it in any size. This means that there are many housewives who can not have the labor-saving arrangement that good planning provides, and that money has been spent for the construction of useless space which requires still more money for its maintenance. The labor saving plan, therefore, is a money-saving plan, and the elimination of waste space is one of the most important factors of economy. For this reason the small house should not have two dining places, such as a breakfast nook or other kitchen space in addition to a dining room, and also because only one table can be conveniently placed in relation to the kitchen equipment.

A study of nearly four hundred rural Nebraska kitchens, which was made by the University of Nebraska this spring, indicates that architects and builders should pay greater attention to storage space and illumination, as well as to the arrangement of equipment. More than half of the kitchens in the survey did not have enough storage space, most of them being short of room for staples and cleaning supplies; more than half of them did not have enough artificial illumination, and only a little over half of them had enough daylight. Lighting is judged by its total amount and by its amounts at work surfaces, so that compact kitchens with high backed stoves and cabinets must sometimes have windows in every available space, in order to have a satisfactory amount of daylight. In order to have enough artificial illumination the ceiling light should be placed wherever it will do the most good, even though it be off center, and side lights should be placed wherever they are necessary.

The study of Nebraska kitchens led to a review of the kitchens of ready-cut houses or the ready-made house plans which are offered for sale by various agencies. These plans were classified in regard to convenient kitchen arrangement as excellent, good, fair, and poor. More than one hundred that were shown by the Sears-Roebuck and Montgomery Ward companies were examined, but none of them were found to be excellent, and only 7 per cent were found to be good; 25 per cent were classified as fair, and 68 per cent as poor. One hundred plans were taken at random from the Architect's Small House Service Bureau, but only 3 per cent of them were considered excellent, and only 20 per cent good; 23 per cent were classified as fair, and 54 per cent as poor.

This high percentage of poorly arranged plans indicates that there is a corresponding percentage of badly arranged kitchens, which are not only wasteful, but unhealthful as well. The additional exercise that is made necessary by improper arrangement, and which frequently amounts to two miles a day of indoor walking, makes kitchen work harder and less enjoyable and, for that reason, it is often detrimental to health and happiness. Abraham Meyerson*, of the Massachusetts Commission on Mental Diseases, thinks that the reaction to conditions of housework is an important causative factor in the neurosis of the housewife. He recommends, among other preventive measure, more labor-saving contrivances and better housekeeping methods.

The average length of the farm woman's working day is from ten to thirteen hours, according to reports of time studies, so it is of the utmost importance for her to have the labor-saving arrangement that is also time and health saving. Not only her kitchen but the whole farmhouse should be planned for the greatest convenience and comfort. It should have the best arrangements for recreation as well as for work, and every adaptation to the needs of farm life that can be suggested by the engineer, the architect, the hygienist, the economist, or any other specialist.

*Meyerson, A. "The Neurosis of the Housewife," Bulletin of the Massachusetts Commission on Mental Disease, January 1919.

An Object Lesson In Reforestation

AN OUTSTANDING object lesson to the American people on reforestation is the private reforestation project started by Thomas C. Luther, in 1901, on 65 acres of land in Saratoga County, New York. This project has been expanded from year to year and at the present time has more than two million trees planted on between five thousand and six thousand acres. In addition to this he has eight or ten thousand acres of land near Lake George and Lake Champlain, with an ambition to plant ten million more trees. The steady growth of Mr. Luther's timber holdings has been the result of a policy firmly adhered to to keep planting each year new trees beyond the amount he cuts for sale, and to insure a steady supply by cutting no trees until they have reached at least a twelve-inch stump.

His original plot of 65 acres has now repaid is purchase price of $1050.00 three times and two years ago had a stand of sufficiently grown trees to yield 25,000 feet of oak and pine besides 100 cords of wood, without cutting any trees below his minimum size.

With his son, Thomas F. Luther, who, since studying forestry in Cornell University, has been associated with him in this enterprise, he has pushed his planting ahead steadily and in 1926 expects to plant one million trees, if the state nurseries can furnish them; last year they planted 500,000 trees. The planting is done under the personal supervision of father and son at a rate of between fifty and sixty thousand trees a day, a grand total of 1,200,000 trees having been planted in a single season in 1921.

The Gothic Barn Roof With Sprung Rafters

By F. E. Fogle

Mem. A.S.A.E. Assistant Professor of Agricultural Engineering, Michigan State College

IT IS believed that the gothic type of barn roof, by which is meant one having rafters of a circular curvature meeting at a peak, originated in Michigan. Barns with roofs of this sort were built as early as 1885 in Isabella County, and in that county today there are several townships in which there is almost no other type of roof.

At first the rafters of these roofs were made of 2-by-12-inch planks with the top edges sawed to the desired curvature. Later they were made with a greater curvature by using one-inch boards 8 or 10 inches wide and 3 or 4 feet long, sawed with a curve of the desired radius and then nailed together with broken joints to form a laminated rafter. Both of these methods were wasteful of both material and labor.

To avoid this wastefulness and yet preserve the appearance and other features of the gothic roof experiments were made with the sprung rafters. The first barn embodying this construction, so far as known, was erected in 1892, but it did not come into extensive use until after 1900, by which time its success was demonstrated and it largely superseded other types of rafters in new construction. In Fig. 1 is shown a barn built in 1900 with sprung rafters on a Shawver truss frame. The curvature is considerably less than later became popular.

The sprung or bent rafter is of laminated construction, but with the joints between the laminae parallel to the surface of the roof instead of vertical. It usually is built up of four or five plies of material, 1 by 4 inches in cross section and as long as conveniently may be, care being taken that successive joints are not closer together than 4 feet. The material should be uniform in width and thickness, and it is important that while tightly clamped in the form the strips be nailed tightly together with an abundance of 12 to 16-penny nails driven from both top and bottom, and it is considered desirable also to use a ⅜-inch bolt every three or four feet.

The construction of the form and its manner of use are shown in Fig. 2. A strong level platform of suitable size and shape is provided and on it is laid out the desired arc. Every two feet along this line is nailed a pair of blocks made of 2-by-4 material as shown. The space between the blocks of each pair is sufficient to admit not only the desired number of strips, but also a wedge for crowding the strips tightly together for nailing. Guides for sawing the ends of the rafters at the correct angle are embodied in the form, and this sawing is done before the rafter is removed.

The amount of labor required to make rafters of this kind is about the same as for rafters of an equivalent self-supporting gambrel roof. For example, carpenters experienced in the building of sprung rafters say that a crew of four men can build the platform and forms for a 36-by-60-foot barn in one-half day and complete the rafters in one and one-half to two days. The curvature to which sprung rafters are built varies greatly with the taste and other ideas of the builders. If too near straight the appearance is not pleasing, and the haymow space and headroom which are practical features of the design are sacrificed. On the other hand, if the curvature is too great the roof will be flat at the ridge and liable to sag. To meet this particular condition there have been noted a few roofs in which the upper five or six feet of the rafters were left straight, bringing them together at a more acute angle, preventing the slope from becoming unduly flat and giving, to some eyes at least, a better appearance. Rafters of this type are spaced two feet from center to center.

In the drawings accompanying this article is shown the more usual practice of butting the lower end of the rafters on the plate, with short stub rafters flaring rather sharply outward to form the eaves. Some builders, however, employ only the lower plies of the rafters for the butt joint with the plate, leaving the two top plies sufficiently long to project beyond the plate and form the eaves. This method has the advantage of permitting a more secure nailing between rafters and plates. When it is employed the extending portion of the top plies should be given a spring in the reverse direction, both in the interest of better appearance and to carry roof drainage farther from the wall. Gothic roofs with sprung rafters may be used either as self-supporting roofs as shown in Fig. 3, or on Shawver truss framing, as shown in Fig. 4. It would appear from experience that the self-supporting construction has adequate strength up to a width of 36 feet. There have been failures, to be sure, but insofar as they have been studied they seem fairly ascribable to gross errors in designing or in construction. The adaptability of the sprung rafter to use in a self-supporting roof is of especial value in remodeling timber frame barns, as all that need be done is to take off the old roof, straighten the plates, and put on the gothic roof.

When built on Shawver truss frames the sprung rafter gothic roof is very rigid, and in consequence of the rafters being supported near their middle, there is much less liability of the roof becoming uneven as compared with the self-supporting frame. However, it is to be noted that a sprung roof invariably shows some uneveness of its surface, due to the practical impossibility of maintaining such a high degree of uniformity in workmanship and material as to prevent minor variations in curvature. It is apparent from the nature, or rather the cause, of such irregularities, that they do not

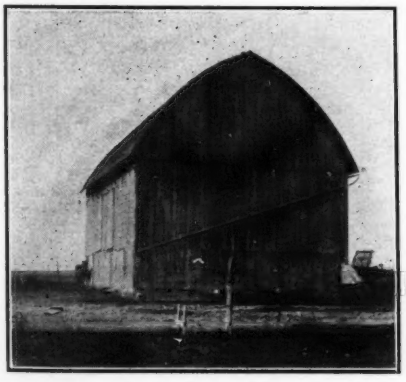


Fig. 1. Sprung rafter gothic roof built in 1900 on a Shawver truss frame, showing small curvature at first used. Its appearance may be contrasted with Fig. 5

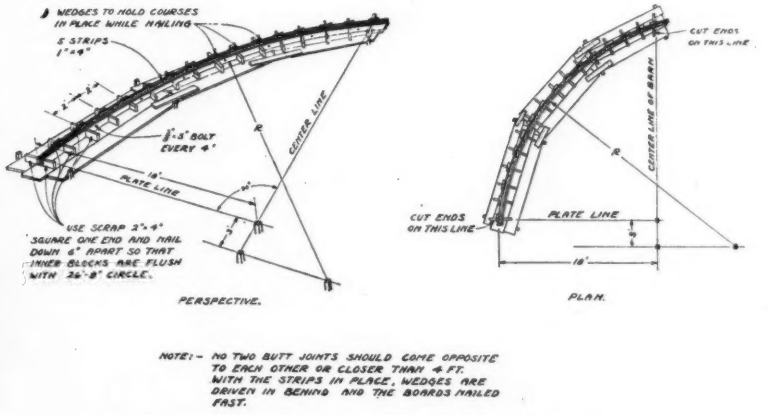

WEDGES TO HOLD COURSES IN PLACE WHILE NAILING
5 STRIPS 1"x4"
⅜"-5" BOLT EVERY 4'
CENTER LINE
PLATE LINE
USE SCRAP 2"x4" SQUARE ONE END AND NAIL DOWN 6" APART SO THAT INNER BLOCKS ARE FLUSH WITH 26'-8" CIRCLE.
PERSPECTIVE.
CUT ENDS ON THIS LINE
CENTER LINE OF BARN
CUT ENDS ON THIS LINE
PLATE LINE
PLAN.
NOTE:- NO TWO BUTT JOINTS SHOULD COME OPPOSITE TO EACH OTHER OR CLOSER THAN 4 FT. WITH THE STRIPS IN PLACE, WEDGES ARE DRIVEN IN BEHIND AND THE BOARDS NAILED FAST.

Fig. 2. Manner of laying out and building forms for sprung rafters

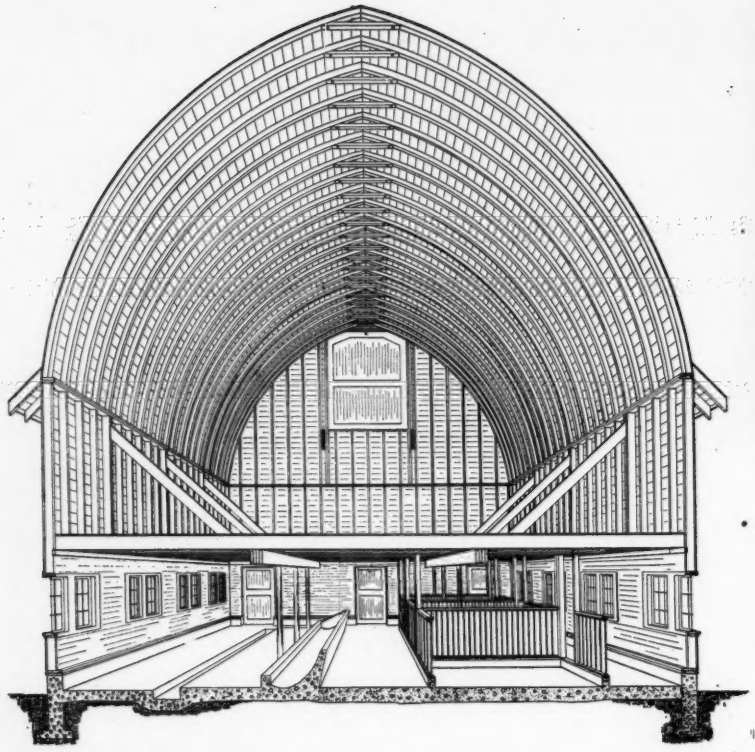


Fig. 3. (Left) Interior perspective view of a self-supporting gothic roof on a wing joist frame. The collar joists, about four feet long, bolted to the upper ends of the laminated rafters resist sagging at the ridge

Fig. 5. (Above) A gothic-roofed barn of late construction, showing the greater curvature which now prevails, as compared with Fig. 1. This barn has a timber frame and purlin plates

of necessity indicate structural weakness.

Reverting to the degree of curvature to be employed, Fig. 5 shows a barn of recent construction in which the tendency towards greater curvature may be contrasted with Fig. 1. It may be said that it is now considered good practice to use two-thirds or three-quarters of the width of the barn as the radius of rafter curvature, and to locate the center of the arc about three feet below the top of the plate.

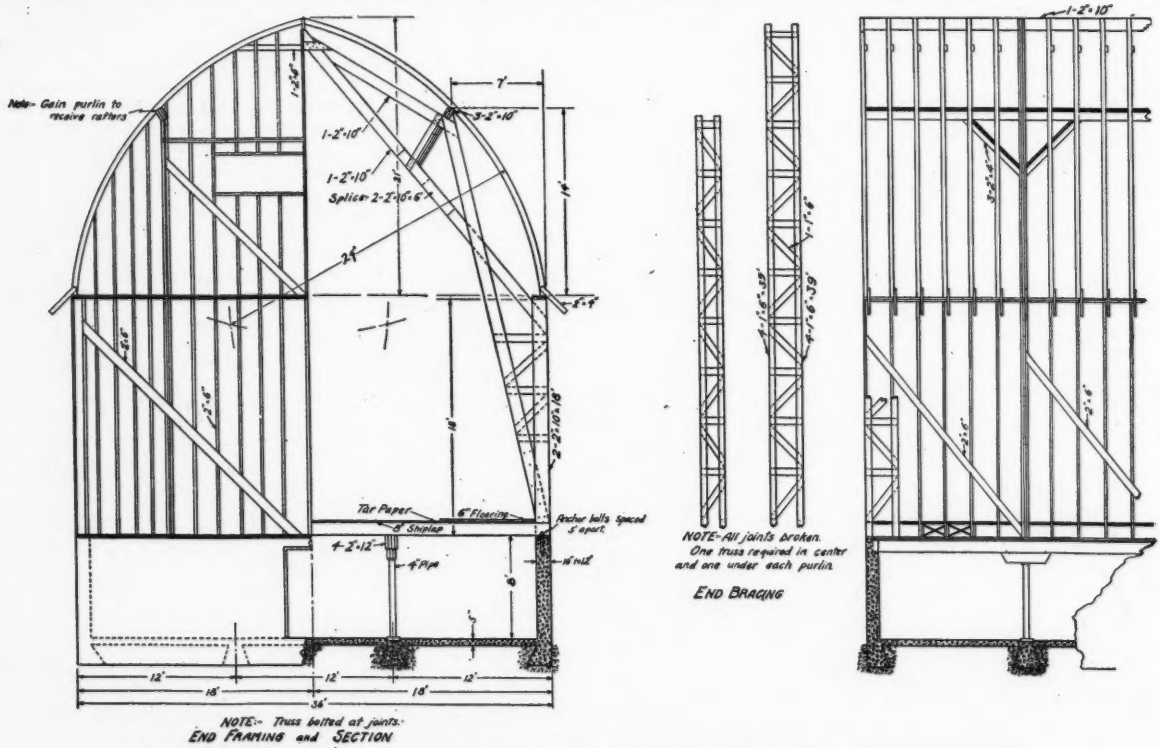


Fig. 4. Framing details for sprung rafters gothic roof in connection with Shawver truss construction

Research in Agricultural Engineering

A department conducted by the Research Committee of the American Society of Agricultural Engineers

The Kinematics and Dynamics of the Wheel Type Farm Tractor

By E. G. McKibben

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EDITOR'S NOTE: This is the first of a series of articles on the kinematics and dynamics of the wheel-type farm tractor. The material presented in these articles was obtained as the result of an agricultural engineering project of the agricultural experiment station of the University of California. It has been edited and approved by the Research Committee of the American Society of Agricultural Engineers. These articles will appear in seven consecutive issues of AGRICULTURAL ENGINEERING, under the following headings:

I. Kinematics
II. Dynamics—Locating the Center of Gravity
III. Dynamics—External Forces
IV. Dynamics—Turning Moment of External Forces
V. Dynamics—Stability
VI. Dynamics—Normal Soil Reactions at Front and Rear Wheels, and Drawbar Pull
VII. Conclusions and Lecture-Demonstration Apparatus

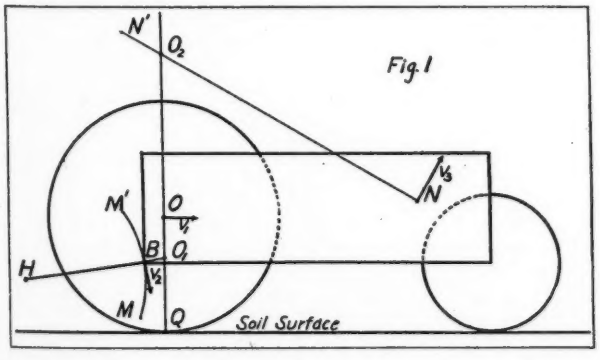
IF THE agricultural engineer who is specializing in farm power is to make his best contribution to the agricultural engineering profession, if as an agricultural engineer he is to earn and hold a recognized place among other engineers, he must have more than the garage mechanic's conception of the tractor. He must visualize the tractor as a unit and have a clear conception of all forces acting upon it. He must be informed concerning the fundamental laws of mathematics and physics which govern its kinematic and dynamic responses to these forces. In no other way will he be able to make the tractor perform its maximum service.

The purpose of this series of articles is to show by means of a careful analysis using the proven principals of mathematics and physics, first, the form and characteristics of the motions which may be taken by a tractor and, second, the relationship between, and the tendency results produced by, the various forces acting upon a tractor. The conclusions reached as a result of this mathematical analysis were checked by laboratory studies and found to be correct within the limits of experimental error.

I. KINEMATICS

Since the motion of a tractor is constrained by the contact of one or more of its wheels with the soil and by its drawbar attachment to a load, it seems logical to study first the possible motions (kinematics) and second the possible forces which can be present and which are required to produce these motions (dynamics).

Rectilinear and Curvilinear Motion. Any position taken by a tractor in a plane perpendicular to its axles may be obtained by motion parallel to the contact surface of the soil on which the rear wheels are traveling and rotation of the wheels, or frame, or wheels and frame about an axis through the center of the rear wheels. If the soil presents a plane surface this means rectilinear motion parallel to the soil surface, or rotation about an axis through the center of the rear wheel, or a combination of these two motions.



Instantaneous Axis of Rotation. (See Fig. 1.) If these motions are combined at any instant their resultant is the actual motion taken by the tractor. This resultant may be considered as rotation about an instantaneous axis. The location of this instantaneous axis of rotation depends, first, upon the relative magnitude of the rectilinear motion parallel to the soil surface, and of the rotation about the axis of the rear wheels, and, second, upon the base to which the rotation is referred.

However, since the center of the rear wheels must remain a constant distance from the soil surface, its motion must at all times be parallel to the contact surface of the soil on which the rear wheels are traveling, or perpendicular to the line OQ of Fig. 1. Therefore the instantaneous center of rotation of the tractor frame must at all times be located on OQ, or OQ extended.

Therefore, with respect to the drivewheels the frame rotates about point O, the center of the rear wheels.

With respect to the load, hitch point B of the tractor frame can have motion only along the arc MM', and at any instant will have a motion tangent to arc MM' (whose center is the implement hitch point, H), and perpendicular to line HB. Thus, with respect to the load the instantaneous axis of any rotation of the tractor frame is about O_1, the intersection of lines OQ, or OQ extended and HB, or HB extended.

If there is no motion of the tractor parallel to the surface of the soil, point O will be stationary with respect to the earth and any rotation of the tractor frame with respect to the earth will be about O. If the load is stationary and the front of the tractor is rising then any rotation of the tractor frame with respect to the earth will be the same as with respect to the load, that is, about an instantaneous axis through O_1.

If both the tractor and the load have motion parallel to the soil surface, it is only necessary to know at any instant the direction of motion with respect to the earth of any point, such as N, outside of O. The instantaneous axis of rotation of the tractor frame with respect to the ground will be at O_2, the point of intersection of QO, or QO extended, with a line

Notation of Fig. 1

B, point of attaching hitch to rigid frame of tractor
H, point of attaching hitch to rigid frame of implement
MM', arc generated by motion of point B with respect to H as front end of tractor rises
N, any point outside of O
NN', line through N, perpendicular to direction of v_3
O, center of rear axle
O_1, point of intersection of lines HB and OQ
O_2, point of intersection of OQ and NN'
Q, point where line through O, perpendicular to the direction of motion of point O, strikes the soil surface
v_1, linear velocity of point O with respect to the earth
v_2, linear velocity of point B with respect to H or O
v_3, linear velocity of point N with respect to the earth

NN' through N perpendicular to the direction of motion of N.

If the tractor has only rectilinear motion the direction of v_s will be parallel to v_t. Therefore, lines QO and NN' will be parallel, and their point of intersection, O_2, will be at an infinite distance. Thus the tractor may be considered as rotating about a circle with an infinite radius, a consideration which may be applied to any body having only rectilinear motion.

As will be shown in a later article, it is possible to obtain practically all the important dynamic facts concerning a tractor without knowing the exact location of the various axes about which it rotates as it rises in front under different conditions. However, in order to prevent the formation of false conceptions and the drawing of erroneous conclusions it is desirable, if not essential, that the designer, instructor, or student have a clear conception of the kinematics of the tractor, including the possible axes of rotation.

EDITOR'S NOTE: The second article of this series, under the heading "Dynamics—Locating the Center of Gravity," will appear in the February issue of AGRICULTURAL ENGINEERING.

Industrial Standardization During 1926

NOTABLE developments in the industrial standardization movement, including important progress in the mechanical and mining industries, in industrial safety, its further extension through managerial and trade association activities, and forward steps in international cooperation, have been achieved during 1926, according to an announcement of the American Engineering Standards Committee, which states that standardization was the subject of a special report at the recent conference of the premiers of the British Empire.

Instead of leaving their standardization work as a more or less incidental function of the engineering and production departments, industrial executives are more and more providing a definite organization for their standardization work. This was well illustrated during Management Week when scores of meetings of industrialists and Chambers of Commerce, held all over the country, were devoted to the consideration of the standardization and simplification problems which are met by the works manager and his associates.

The systematic organization of company standardization work is leading to a much larger degree of cooperation between companies. For example, in the Cleveland industrial district the men in charge of this work for a large group of important companies have organized for mutual assistance in the work. Through this more than thirty Cleveland firms have reorganized their screw thread practice in accordance with the revised national standard, and more than a dozen firms have systematized their entire control of interchangeable manufacture through the introduction of the new national standard of limit gaging.

International Cooperation. In April there were held in New York the most important group of international conferences on standardization ever assembled. Of these the two principal features were the meeting of the International Electrotechnical Commission with its group of technical committees, and the Third Conference of the National Standardizing Bodies, in connection with which there were international technical conferences on screw threads, ball bearings, gages, and preferred numbers. In each of these technical conferences real progress was made toward bringing about international uniformity in industrial practice in the different countries. Twenty countries from Europe, Asia and South America were officially represented.

During the conferences a basis was laid for what it is hoped will soon become a unified international standardizing body covering the general field of industrial standardization. In September, committees of the two groups met in London, at which time further steps were taken. Final agreement upon a unified plan has not yet been consummated, there naturally being difficulties inherent in a problem involving a group of national as well as international organizations. The relation of the International Electrotechnical Commission, a specialized organization, to a general standardizing body, into which work from the national industrial standardizing bodies shall feed, is of special importance in this country.

Government Activities. The fifth year of Mr. Hoover's Division of Simplified Practice shows steady development. About fifty simplifications have been carried through. These include a wide range of commodities from bed springs to shot gun shells, and from milk bottles to range boilers. In a survey of nineteen of these commodities it is stated that from 51 to 99 per cent of the sales are in accordance with the simplified practice recommendations, the average of the nineteen being 79 per cent.

The unification of government specifications under the Federal Specifications Board has now reached a point where the main lines of government commodities are covered. More than 400 specifications have been approved, and a considerable number have reached the second edition. While contact with industrial groups has been maintained in the work, to a very considerable extent through the American Engineering Standards Committee, much yet remains to be done in thoroughly coordinating these government specifications with those in general use in the industries.

The U. S. Bureau of Standards has proposed an interesting plan of certification under which any manufacturer who is willing to supply goods made to comply with a given government specification, may file with the Bureau a statement to that effect. Consumers upon request will be given a list of such manufacturers. This plan has been widely discussed in a large number of organized industrial groups, since this proposal in some form may ultimately have far-reaching effects upon sales policies and upon our present method of distribution.

Mechanical Standards. The work of the sectional committee on tooth form of spur gears, which has been in progress for several years, has been completed and has been submitted for the formal approval of the A.E.S.C. as a Tentative American Standard. Several parts of the comprehensive work on bolt, nut and rivet proportions, are now nearly completed, and the same is true of several sections of the work on pipe flanges and fittings. It is expected that the first of these to be issued will be that on high pressure steel flanges which, although not yet officially completed, is already practically the sole basis of industrial practice in recent advances in high pressure steam practice.

Railways. More than a hundred million railway ties are produced in this country yearly. During the year specifications satisfactory to both the steam railways and electric railways have been agreed upon for the first time. It is an interesting illustration of the manifold interrelationships of modern industry that eleven national organizations were officially represented on the sectional committee through which this unification of specifications has been accomplished. Specifications for tubular steel poles and for girder rails have also been unified and approved as Tentative American Standards.

Safety Codes. Twenty of the fifty codes on the national safety code program have now been approved by the A.E.S.C. Among those receiving approval during 1926 were a group of codes for the prevention of dust explosions, and new editions of the codes for abrasive wheels and punch presses.

A particularly important development has been the revision of the "National Electrical Code", which is the industry's bible for wiring devices. This included a settlement by almost unanimous action of a controversy of three years' standing over the admission as approved material of non-metallic sheathed cable. This new material was approved for limited uses.

In connection with the safety code program, and upon the initiative of the state industrial commissions, arrangements have been made for a revision of the standard plan of reporting and compiling accident statistics under the procedure of the American Engineering Standards Committee. This plan forms the general basis of the accident statistics of the various state governments and of the casualty insurance companies.

Agricultural Engineering Digest

A review of current literature on agricultural engineering by R. W. Trullinger, specialist in agricultural engineering, Office of Experiment Stations, U. S. Department of Agriculture

The Wind-Driven Electric Light Plant, F. C. Fenton (Iowa Agricultural College Official Publication, Ames, 24 (1926), No. 32, pp. 6-9, figs. 3).—Data from experiments at the Iowa experiment station on wind-driven electric light plants are briefly presented.

It was found that in most respects the airplane propeller wheel is apparently an improvement over the old type of windmill wheel, although the output of current, judging by three months' observation, was somewhat less than from the old type wheel. The airplane wheel began to send current into the batteries at a wind velocity of about ten miles per hour. The current increased rapidly as the wind velocity increased from fifteen to twenty miles per hour. Wind velocities above twenty-five miles per hour brought little increase in current because the wheel did not remain facing the wind. This is taken to indicate that the propeller may be somewhat more efficient in high winds than the old type wheel. However, it is much less efficient in low winds because it cannot utilize winds with a velocity below ten miles per hour.

Domestic Heating, M. Fishenden (Journal of Royal Society of Arts, London, England, 74 (1926), No. 3828, pp. 452-469).—A detailed discussion is presented of some of the technical features of proper domestic heating from the British viewpoint. It is pointed out that for continuous heating in small rooms air heating is generally the cheapest method, but as the size of the room increases open coal or coke fires become cheaper, especially if there are only a few people present. For very large rooms, open fires alone become impracticable and some form of air heating must generally be used.

Experimental Impact Studies on Highway Bridges, A. H. Fuller and R. A. Caughey (Iowa Engineering Experiment Station Bulletin 75 (1925), pp. 61, figs. 45).—This is a progress report of work on the subject previously noted (Agricultural Engineering, vol. 4, p. 130), which is being done in cooperation with the U. S. D. A. Bureau of Public Roads and the Iowa State Highway Commission.

The stringer spacing in concrete floor bridges did not vary sufficiently to permit the drawing of general conclusions. The observed stresses in all instances were far below the computed ones. For a truck loaded to give approximately the proportions of front and rear axle loads, now generally specified in highway bridge specifications, and traveling at a rate of speed of twelve miles per hour, the impact increment of stress in the stringers and the floor beams under smooth concrete floors, stressed well toward allowable limits, was below 15 per cent. When the wheels of the truck ran over 1-by-2-inch obstructions, the percentage was about 50, and for 2-by-4 inch obstruction, the percentage was about 100. The impact in the floor system of timber floored spans varied greatly with the conditions of the individual floor, and a general statement could not be made.

The relationship between speed and dynamic stress and also between speed and dynamic force was so nearly a straight line relationship that this interpretation was generally made.

Experiments on Making Hay with Heated Air, J. Hendrick (Scottish Journal of Agriculture, Edinburgh, Scotland, 9 (1926), No. 2, pp. 136-146).—Experiments conducted at the University of Aberdeen on the use of heated air for the drying of hay are reported. Three experiments were conducted on three different stacks, and commercial drying machines were used.

The temperature of the air blown into the stack varied from a little less than 100 to over 130 degrees Fahrenheit. The results were not satisfactory, and were taken to indicate that under certain conditions difficulties arise with the method of drying crops devised at Oxford University. The experiments were considered unsuccessful primarily because the stacks of hay were not fully dried. The second objection was that the consumption of fuel was very great, although the stacks were not completely dried. Even had the drying been successful the consumption of fuel would have made the process uneconomical.

Cement-Lime Mortars, H. V. Johnson (U. S. Department of Commerce, Bureau of Standards Technological Paper 308 (1926), pp. 241-274, figs. 14).—Tests upon cement-lime mortars are reported in which the percentages of cement, lime, and sand were varied considerably. It was found that the addition of lime to cement mortars increased the water requirement for the same consistency very nearly in proportion to the percentage of lime added. Shrinkage was increased by the addition of extra water. This is taken to indicate that where low shrinkage is of prime importance, lime should be limited in cement mortars. The addition of lime in small amounts increased the density of lean cement mortars. The principal advantages resulting from the use of lime in cement mortars were found to be an increase in workability and a reduction in cost.

A Portable Summer Colony House for Pullets, D. C. Kennard (Ohio Station Bimonthly Bulletin, 11 (1926), No. 3, pp. 115-119, figs. 5).—Practical information on the construction of a portable summer colony house for pullets adapted to Ohio conditions is presented, together with working drawings and a sample bill of materials.

Highway Curves and Earthwork, T. F. Hickerson (New York and London: McGraw-Hill Book Co., 1926, pp. XIV+382, figs. 50).—This handbook presents briefly the problems of highway location, laying emphasis on the subject of curves and earthwork, including the banking and widening of pavements. The economic and aesthetic advantages of easement spirals are explained, and a variety of original tables is presented to facilitate the layout of these curves. A theoretical treatment of curves illustrated with numerous examples is also given.

The Gas Engine on the Farm—II, Starting Troubles and Their Remedy, F. L. Fairbanks and F. G. Behrends (New York Agricultural College (Cornell) Extension Bulletin, Ithaca, 1133 (1926), pp. 60, figs. 43).—Practical information on troubles encountered in the starting of farm gas engines and the remedies therefor is presented.

Tests Show How Calcium Chloride Affects Concrete, A. S. Levens (Engineering News-Record, New York, 97 (1926), No. 6, pp. 214, 215, figs. 4).—Studies conducted at the University of Minnesota to determine the effect of calcium chloride when used as an integral part of the mix upon the tensile and compressive strengths and the shrinkage effects of concrete are reported.

In the tension tests the strongest concrete was that which contained 2 per cent of calcium chloride and was cured one day in the moist chamber and then dried. Percentages of calcium chloride over 2 tended to weaken the concrete. During the earlier periods of set the increase in strength of the concrete containing 2 per cent of calcium chloride was 40 per cent greater than that of plain concrete. After twenty-one days concrete containing from 2 to 3 per cent of calcium chloride was stronger than concrete containing no calcium chloride, but the difference in strength was not very great.

In the compression tests an enormous increase in strength was noted during a very short period, amounting to 106 per cent over that of plain concrete. The strongest cylinders were those containing 2 per cent of calcium chloride and cured in air for the entire period.

In the shrinkage tests the use of calcium chloride increased the shrinkage and hastened the setting time, this continuing throughout the entire test period.

The Improved Semi-Monitor Poultry House, D. C. Kennard (Ohio Station Bimonthly Bulletin, 11 (1926), No. 3, pp. 120-123, figs. 2).—Practical information is given on the construction of an improved semimonitor poultry house, together with a working drawing.

Alumina Cements and Sulphate Water, D. G. Miller (Concrete [Chicago], Cement Mill Ed., 28 (1926), No. 4, pp. 29-31).—The results of experiments conducted by the Minnesota experiment station, the Minnesota department of drainage and waters, and the U. S. Department of Agriculture are reported.

Laboratory tests indicated that high alumina cement concrete reaches its ultimate strength at about seven days, and that thereafter the strength remains constant. All high alumina cement concrete and mortar cylinders, regardless of curing conditions, showed an average strength ratio considerably above 100 per cent after one year's exposure to the sulphate waters of Medicine Lake, South Dakota, as compared with cylinders from the same lots stored in tap water in the laboratory.

One series of the French high alumina electric cement stored in the laboratory in a 1 per cent solution of sodium sulphate had a strength ratio at one year of 101 per cent as compared with cylinders from the same group stored in tap water in the laboratory. Tests at two years were less favorable as the strength was but 75 per cent, indicating a necessity for later tests before drawing conclusions. With two exceptions none of the high alumina cement cylinders showed any appreciable surface action. These results are taken to indicate the necessity for a hardening period for all high alumina cement concrete exposed to the action of sulphate waters.

All the tests indicated that high alumina cement is perhaps somewhat more resistant to the action of sulphate waters than is most standard Portland cement. However, it is not 100 per cent resistant. It was found not feasible to mix alumina cement and standard Portland cement except within very narrow limits.

Development of the Electric Dairy Sterilizer in California, B. D. Moses (Journal of Electricity, San Francisco, Calif., 56 (1926), No. 9, pp. 325-328, figs. 4).—In a contribution from the California experiment station data are reported which indicate that in the sterilization of dairy utensils heat conservation is of great impor-

tance, a reduction in radiation losses making possible the use of a thermostat and the increasing of time of sterilization without added costs.

The results are taken to indicate that the ideal sterilizer is one which uses the heating element just large enough, the correct quantity of water, and insulation to the extent that a thermostat cutting out the power between 200 and 210 degrees Fahrenheit will result in a minimum consumption of electrical energy and will have a safe margin of exposure to a sterilizing temperature of 170 degrees.

Protecting the Farm Against Fire, M. L. Nichols and T. B. Chambers (Alabama Station Circular 49 (1926), pp. 14, figs. 6).—Practical information on the protection of farm buildings against fire, derived mainly from investigational work done on the station farm, is presented. Data on fire-fighting equipment which was tested are also presented, special attention being drawn to the use of pressure water supply tanks for this purpose. Hose tests indicated that the 5/16-inch nozzle outfit is the most desirable equipment, since it gives the operator the opportunity of using approximately twice the capacity of the pump for several minutes, or permits the use of a continuous stream at high pressure to protect one building from another.

[Agricultural Engineering Studies at the Colorado Station], R. L. Parshall and G. A. Cumings (Colorado Station Report 1925, pp. 35, 36, 40-42).—A brief description of investigations on the measurement of irrigation water is presented, which includes data on the development of an improved Venturi flume of small size for field use (Agricultural Engineernig, Vol. 7, p. 26).

Preliminary tests on a double-hump hydraulic jump flume with the idea of increasing the degree of submergence before interference with the free flow did not show any marked improvement over the improved Venturi flume.

Investigational work on humidifying air in buildings showed that the relative humidity of inside air was very low, being an average of 15-18 per cent during the winter months and in extreme cases running as low as 8 per cent. The average relative humidity of inside air with an outside air temperature of 0 degree Fahrenheit was 12 per cent, and as the outside air temperature increased there was an increase in the relative humidity of inside air due to a greater opening of windows and a greater evaporation of moisture outside. When the temperature of outside air reached 50.68 during the month of April, the relative average humidity of inside air was 19.5 per cent.

The V-shaped humidifier pan, which hangs on the back of steam or hot water radiators and extends into the radiator between the columns, evaporated 2.75 times as much water as similar pans now on the market. It was also found that increasing any dimension of the pan increased the rate of evaporation. The crash-fiber humidifier consisting of strips of crash running from an upper water pan to a lower water pan, and an electric fan for circulating the air evaporated only a small amount of moisture and showed only a negligible increase in the relative humidity of inside air.

The average relative humidity of air during cold weather in a four-room private dwelling with a water pan in a hot-air pipeless furnace was 32.9 per cent. With a circular V-shaped humidifier pan installed in the hot-air pipe under the register the relative humidity was 36 per cent. With both pans in operation, the relative humidity was 45 per cent.

Data on the treatment of alkali water for drinking purposes are also included.

Results of Laboratory Electric Range Studies, M. Rapp (Iowa Agricultural College Official Publication, Ames, 24 (1926), No. 32, pp. 9-11, fig. 1).—Experiments conducted at the Iowa experiment station are briefly reported which indicate that on the closed type of unit water is heated at the least cost with aluminum tea kettles, while with the open type of unit the copper and nickel tea kettle is the most economical.

A 5-pound beef roast cooked by means of an insulated cooker unit required less than half the amount of fuel used by the oven in cooking the roast. At 5 cents per kilowatt-hour the oven cost was 8.8 cents, and the insulated cooker unit cost 3.7 cents.

A comparison of insulated ovens for baking potatoes showed that the oven with little insulation required almost twice the amount of fuel for this process as the oven which was heavily insulated. These results are taken to indicate that while the original cost of the insulated oven is greater than that with little insulation, the saving in fuel may tend to equalize his expense in time.

The conclusion is drawn that the most efficient utilization of the range oven is accomplished by careful planning in the use of the oven for long processes, as a large amount of fuel is consumed in preheating the oven to a baking temperature.

Effect of Various Carbon Pigments on Rate of Oxidation of Linseed Oil, F. H. Rhodes and H. E. Goldsmith (Industrial and Engineering Chemistry, Washington, D. C., 18 (1926), No. 6, pp. 566-570, figs. 8).—Studies conducted at Cornell University are reported which showed that the addition of lampblack or carbon black to raw linseed oil very markedly inhibits the oxidation of the oil. This is not due to the presence of oily or oil soluble impurities in the pigments but to the continuous absorption of the intermediate oxidation product which acts as the true catalyst in the drying reaction.

The carbon pigments only slightly retard the oxidation of freshly prepared paints containing cobalt drier. The inhibiting effect becomes more pronounced as the paints are allowed to stand, due to the gradual adsorption of the cobalt drier by the pigment.

When added to linseed oil containing lead drier carbon black and lampblack were found to inhibit almost completely the oxidation of the oil during the first few hours of exposure. This is attributed to the fact that the pigments adsorbed not only a portion of the lead drier but also the small amount of autocatalytic oxidation product that is formed at the beginning of the oxidation.

Carbon pigments were found to have little effect on the rate of oxidation of linseed oil containing manganese drier.

Flow of Water in 54-inch Concrete Conduit, Denver, Colo., F. C. Scobey (Engineering News-Record, New York City, 96 (1926), No. 17, pp. 678-680, figs. 3).—Tests conducted by the U. S. Department of Agriculture Bureau of Public Roads of a 54-inch reinforced concrete conduit are reported which showed the capacity greater by 15 per cent than that accepted for the best conduits a few years ago. The results are taken to indicate that the Scobey formula, $V=C_s H^{0.5} d^{0.625}$, with a coefficient C_s of 0.37, as recommended for the best of concrete pipe, is very conservative. In this formula V is the velocity in feet per second, H is loss of head in feet per 1,000 feet of pipe, and d is internal diameter in inches.

Absorption of Carbon Dioxide by Coal, E. Sinkinson and H. G. Turner, Industrial and Engineering Chemistry, Washington, D. C., 18 (1926), No. 6, pp. 602-605 fig. 1).—Studies conducted at Lehigh University are reported which showed that the greater adsorptive power of anthracite over bituminous coals appears to lie in the character of the carbon present and in its quantity.

The lower activity of the charcoals from coals as compared with artificially prepared charcoals may be due to an infiltration of bituminous matter into the pores of the adsorbent. Inhibition also may be the result of condensation of oxidation products previously adsorbed in gaseous form. It was shown that with coal carbon dioxide will produce elevations of temperature above those obtained with oxygen under similar conditions. It is suggested, therefore, that carbon dioxide plays an important role in spontaneous combustion by producing an immediate rise in temperature through the adsorptive energy between the coal and the gas.

Compressive and Transverse Strength of Hollow Tile Walls, A. H. Stang, D. E. Parsons, and H. D. Foster (U. S. Department of Commerce, Bureau of Standards Technological Paper 311 (1926), pp. 317-353, figs. 19).—Strength tests of seventy hollow tile walls constructed with ordinary workmanship and built under average indoor conditions are reported. The walls were all 6 feet long, 9 feet high, and were either 8 or 12 inch thick. Fourteen different lots of tile and four different mortars were used in their construction. Twenty-seven of the walls were subjected to a transverse test before being tested in compression under central loading. Fifty-three of the walls were tested in compression under central loading and seventeen under eccentric loading.

The mortar and workmanship seemed to be the most important factors affecting the strength of the end construction walls. Those with cement lime mortar were about 5.1 times as strong as those with lime mortar. The mortar had relatively less effect on the strength of the side construction walls. Those with cement lime mortar had 2.4 times the strength of those with lime mortar. There seemed to be no constant ratio between the strength of the walls and the strength of the tiles, but in general, using the same mortar, this ratio decreased with an increase in tile strength. With the eccentrically loaded walls, the maximum loads supported were about 60 per cent of the loads for similar walls centrally loaded.

The transverse strength of the walls was largely affected by differences in mortar and in the position of the tiles. In general the stronger mortars gave higher transverse strengths, and the walls having the tiles laid on the side were stronger under side load than with the tiles on end.

Electricity in Rural Districts Served by the Hydroelectric Power Commission of the Province of Ontario, Canada, E. A. Stewart (University Farm, St. Paul: Author, 1926, pp. 35, figs. 2).—The results of a survey of the use of electricity in the agricultural districts of the Province of Ontario under the method of operation with governmental assistance are presented.

It was found that the actual percentage of Ontario farms served by the Hydroelectric Power Commission or any of its subsidiary divisions is 2.52 per cent, which is a little less than the average in the forty-eight states of this country. The method of operation with governmental assistance in financing rural electrification apparently has not made it possible to supply any large part of the farmers of Ontario or to secure cheap electricity on the farm. The conclusion is drawn that electricity at low energy rates will not alone solve the problems of rural electrification, but that electrical equipment at a low price is also necessary.

Relation Between Fuel Deposition Temperature and Equilibrium Boiling Point, W. A. Whatmough (Industrial and Engineering Chemistry, Washington, D. C., 18 (1926), No. 6, pp. 609-612, figs. 3).—Studies are reported, the results of which are taken to indicate that equilibrium boiling point is a real measure of the volatility of a motor fuel under running conditions. Furthermore, the equilibrium boiling point of a motor fuel is an accurate guide to the induction pipe temperature necessary to maintain a combustible mixture in a stable condition and thereby prevent fuel deposition.

Small Power Plant for Farm and Workshop (Rural Industrial Bureau, [London] Leaflet 26 [1925], pp. 40, figs. 7).—Small power

plants for farm and workshop using water, wind, steam, and internal-combustion-engine power are described. Data on power transmission are included.

Water Supplies and Sewerage Systems for Farm Residences ([Minneapolis]: Minnesota State Board of Health, Division of Sanitation, 1925, pp. 46, figs. 29).—Practical information on water supplies and sewerage systems for farm residences in Minnesota is given.

A Survey of Farm Fires (Harrisburg: Pennsylvania State Police, 1925, pp. 35).—This survey, made by the Bureau of Fire Protection of the Pennsylvania State Police in cooperation with the Pennsylvania experiment station, deals with the causes of farm fires in the state, and gives practical information on prevention. Special attention is drawn to the danger of spontaneous combustion and this phenomenon is discussed in some detail, with special reference to means for preventing its occurrence. A list of thirty-two references to literature bearing on the subject is included.

A Report on the Use of Windmills for the Generation of Electricity (Oxford University, Institute of Agricultural Engineering Bulletin 1 (1926), pp. 63, pls. 6, figs. 11).—Tests of seven windmill generating plants are reported.

The results indicate that the disk area basis of calculation of efficiency gives the multibladed wheels the highest position, whereas on the blade area basis the highest efficiencies are shown by 4- and 5-bladed types. A 4-bladed wheel was found to be the most efficient even at low wind velocities. The next most efficient type was one with semistream-lined metal blades. This was closely followed, and surpassed at low wind velocities, by an improved wheel with the outer trailing edge of each blade rounded off. This resulted in an increased wheel speed, lower cutting-in speeds, and a greatly improved blade area efficiency.

The results are taken to indicate that the cost of electricity generated by windmills either for small lighting or for small power purposes is reasonable and such as to justify a wider use in districts remote from central station facilities.

[Agricultural Engineering Studies at the Minnesota Station] (Minnesota Station Report 1924, pt. 4, pp. 5-13, figs. 6).—Popular discussions are given of some of the experimental work at the station on building materials, profitable farm drainage, the problem of durable draintile, and the cost of clearing land.

With reference to draintile, it is stated that commercial concrete tile are subject to disintegration by the ordinary sulfate salts where found in the soil waters of clay subsoils of the state in quantities exceeding about 0.15 per cent. The severity of the action on concrete of pure solutions of sulfates of magnesium and sodium is somewhat proportional to the strength of the solutions up to 1 per cent. Solutions of from 1 to 9 per cent do not greatly hasten the action.

Laboratory experiments with the newer quick-hardening, high-aluminum cements have indicated that the solution of the problem in the state will probably lie in the general use of some special cement of this type. In addition the resistance of concrete made of Portland cement has in all cases been greatly increased by allowing it to dry and harden in air before exposure to the action of sulfate waters, regardless of how long it has been previously cured in water.

[Agricultural Engineering Studies at the Iowa Station] (Iowa Station Report 1925, pp. 10-12).—Experiments on masonry water tanks are reported to have indicated that it is entirely practicable to build satisfactory farm water supply tanks of masonry and to utilize the silo as a tower without in any way interfering with its use as a silo.

Experiments on the weathering tests of prepared roofing have indicated again that the action of the sun is one of the most destructive agencies, and that a mineral surface of crushed slate, sand, mica, or asbestos seems to contribute greatly to the durability.

Tests of an aeroelectric plant indicate that the plant would furnish an adequate amount of electricity for lighting purposes and for supplying small motors about the home.

Studies of the horse as a motor have shown that it is possible for a horse to exert a tractive pull of more than his weight, and that the ability of horses to pull depends upon their strength and the available footing. However, the ability of the driver and the training of the horse are all-important features in securing a maximum effort. It has been found that a horse at continuous work can exert a tractive pull of one-tenth of his weight while traveling twenty miles each day without intense fatigue, except when it is extremely hot and humid. Keeping the shoulders of the horse in condition is considered to be probably the greatest problem for horses required to give severe continuous service. A significant feature of the horse as a motor is the overload capacity for a short period, running as high as 1,000 per cent for a short pull of ten seconds.

Disposal of Canning Factory Waste, E. F. Eldridge (Canner, Chicago, Ill., 62 (1926), No. 20, pp. 23-26, figs. 6).—A brief discussion of the nature of canning factory wastes and the manner of their decomposition is presented, and data on the design of disposal systems are reported, together with drawings of typical plants. It is stated that in brief a disposal plant for cannery wastes will consist of a screen followed by a tank and finally by filters.

"Combine" and Tractor Feature Farm Machinery Meeting

(Continued from page 7)

controlled by the type of hydrocarbons present and their relative proportion. In all engine fuels the four groups of hydrocarbons represented are the aromatic, naphthene, unsaturated and paraffin. The last group is the worst knocker, while the first three are much better in this respect. In cracking processes it is possible to control the reaction so that desired proportions of the non-detonating hydrocarbons can be produced, and the resulting product blended with straight-run distillates to improve their burning qualities. Ease in starting also is strongly influenced by the type of hydrocarbons present.

Ralph H. Sherry, a consulting engineer of Chicago, presented a paper, illustrated with slides, covering the relationships among materials, design, and manufacture. While going into the matter of materials more technically than can be mentioned here, he emphasized the proposition that the employment of sufficient skill and care in engineering can largely avoid the need for using the more expensive materials. The tendency to blame the material rather than the design or method of manufacture results on the one hand in overlooking errors in the latter and of producing specifications for the former which are entirely unnecessary and which increase costs without bringing corresponding benefit.

He also made the point that tests and specifications for materials are of value only to the extent that they measure the fitness of a material for the use to which it is put, and that the only true and final test is the result given in service. There is a tendency to continue using tests and specifications which have become obsolete and of little significance in relation to changed service conditions.

Among the non-ferrous metals now available to the designer Mr. Sherry mentioned the development of a new method whereby is produced a very uniform bronze with a composition of 70 per cent copper, 19 or 25 per cent lead, and 11 or 5 per cent tin. This alloy can be remelted without segregation of the lead.

In the course of a rather complete discussion of the ferrous metals, both wrought and cast, he paid special attention to the necessity for free flow of the molten metal into the mould if hard shots are to be avoided, and this requirement must be met by providing adequate gates and risers. Accurate control of melting and pouring temperatures are essential to insure freedom from blow-holes and porosity.

Although well-known in a general way, Mr. Sherry finds that designing and production engineers do not attach sufficient importance to the influence of sharp corners, nicks, and even tool marks or drilled holes, as causes of breakage when bending stresses are encountered, mentioning as an example cracking of plow discs from sharp-cornered square bolt holes.

William Parrish, of the International Harvester Company, in a paper on the industrial application of the tractor brought out the rather surprising fact that of the total tractor production to date, about 12 per cent has gone into industrial service. One builder of tracklaying machines sends three-quarters of its products into industry, and another states that of its production not more than 10 per cent goes into agriculture. Even with the Fordson 24 per cent of last year's output went outside the agricultural field.

Road building and other kinds of contracting, railroads, and manufacturing establishments represent the outstanding users of industrial tractors, but the field is so broad that it cannot be described briefly.

T. Warren Allen, chief of the division of control, U.S.D.A. Bureau of Public Roads, presented a paper on the field and requirements for automotive equipment in highway building, describing prevailing practice in this regard, the promise of the future, and in connection with the discussion following brought out a number of facts of interest to the road-building profession, such as the performance of tracklaying tractors with rubber block treads, and the design of a self-loading dump cart.

AGRICULTURAL ENGINEERING

Established 1920

A journal devoted to the advancement of the theory and practice of engineering as applied to agriculture and of the allied arts and sciences. Published monthly by the American Society of Agricultural Engineers, under the direction of the Publications Committee.

PUBLICATIONS COMMITTEE
S. H. McCrory, Chairman
R. W. Trullinger G. W. Iverson
J. B. Davidson F. A. Wirt

The Society is not responsible for the statements and opinions contained in the papers and discussions published in this journal. They represent the views of the individuals to whom they are credited and are not binding on the Society as a whole.

Contributions of interest and value, especially on new developments in the field of agricultural engineering, are invited for publication in this journal. Its columns are open for discussions on all phases of agricultural engineering. Communications on subjects of timely interest to agricultural engineers, or comments on the contents of this journal or the activities of the Society, are also welcome.

Original articles, papers, discussions, and reports may be reprinted from this publication, provided proper credit is given.

RAYMOND OLNEY, Editor

Agricultural Engineering Basic

THE future of agriculture is very largely dependent on agricultural engineering. Hand operations on the farm, as elsewhere, must yield to machine operation wherever feasible; makeshift methods of storing crops and housing animals must give way to effective protection against fire, weather and decay. Arid acres must be watered and unproductive marshes drained. Transportation costs must be reduced and the health and comfort of farm families secured through assured supplies of pure water and proper disposal of domestic waste.

Today it can hardly be said that a man is a good farmer unless he is a reasonably good agricultural engineer. A generation hence the farmer without technical knowledge in these fields will be at an even greater disadvantage. The economics of farm operation will almost rule him out, irrespective of markets and other considerations.

These facts should be self-evident. The remedy lies in recognizing agricultural engineering and accepting it for its face value in our colleges and schools. No student leaving the agricultural college may be properly considered a graduate in agriculture unless he has been schooled in the fundamentals of agricultural engineering. These principles are elementary and the teaching of them may and should begin in the country school house.

A. J. R. CURTIS

A Fraternal Phase of Society Work

NOT long since a member of the Society managing a considerable agricultural project in the West Indies wrote the Secretary's office seeking the experience of other members regarding the merits of certain makes of tractors under the specific and severe conditions with which he has to cope. These conditions, involving both an unfavorable terrain and a primitive type of operating personnel, had resulted in a costly experience with a tractor well known in this country and a favorable experience with another tractor not so well known in American agriculture.

Aside from the fact that comparisons, proverbially odious, are inexpedient for general publication, the conditions represented by this case, and other cases of the sort likely to arise, are not typical of a sufficiently large part of our membership to justify discussion in the columns of the Journal. Yet to such an individual member the considerations involved are of dominating importance, and it seems only proper that the Society should extend such assistance as it can.

The procedure followed in this case, and which is contemplated for similar occasions in the future, was to forward copies of the member's letter to a list of other members, selected with a view to their probable knowledge of the subject matter, as known personally to the Secretary or shown by membership records, togther with a request for replies direct to the inquiring member. It is believed that this procedure is the most efficient way of performing the service desired.

Aside from the part played by the headquarters office as a clearing house, which is a function of the whole Society, this is a distinctly fraternal aspect of Society membership, and so to be considered both by those who give and those who receive. In the opinion of representative members who have considered the matter, this special phase of Society service meets the peculiar situation of our members who by geographical limitations are kept from the personal fellowship of Society, section and division meetings.

Regarding Our Advertisers

THE gradual growth of advertising in these pages is mainly a reflection of the increasing importance of agricultural engineering in our industrial fabric, and greater recognition of the influence of the individual agricultural engineer. We believe that this growth in advertising is sound. It is not the result of high-pressure selling. The Secretary's office uses due diligence in presenting the merits of AGRICULTURAL ENGINEERING to legitimate prospects for advertising.

The Journal is not, in main purpose, an advertising medium, but is intended primarily to disseminate technical information of prime concern to the profession, especially the work of the Society and its members. It is part and parcel of the Society, financially and professionally. Advertising is a by-product sold in the open market for what it is worth. That by-product bears a large part of the cost of producing the Journal and by so much reduces the overhead cost of running the Society. Increased advertising makes possible a bigger and better AGRICULTURAL ENGINEERING.

This Society is not the sort of organization—nor this Journal the sort of publication—in which appeals are made on sentimental grounds for readers to patronize advertisers. The respect and goodwill of our engineer-readers cannot be bought, but can be earned.

The mere fact that a manufacturer or association advertises in our journal carries several important implications. It implies acceptance of the importance of agricultural engineering in the scheme of things. It implies recognition of the influence wielded by the agricultural engineer in determining the sort of equipment, structures, materials and services that shall be employed in farming. It implies a desire of the advertiser to work in cooperation with the agricultural engineering fraternity. It implies a willingness to sell goods or services on the basis of engineering standards as to suitability in application. Finally, it implies on the part of the advertiser that confidence in the technical merit and economic worth of his wares that justifies subjecting them to the critical scrutiny of engineers.

These implications are the basis on which Journal advertising is alike sold to the advertiser and submitted to the reader.

A Correction

Two typographical errors appear in the second column of the article, entitled "The Soil Dynamics Problem," by E. G. McKibben, on page 412 of the December issue of AGRICULTURAL ENGINEERING. Section VI "A" should read as follows: "Degree of plasticity (relative separation of elastic limit and point of rupture)." Section VI "C" should read as follows: "These characteristics, in the case of most materials, are tested for by emperical methods, and expressed by an arbitrary scale."

A. S. A. E. and Allied Activities

Date of Annual Meeting

THE Council of the American Society of Agricultural Engineers has definitely fixed the dates of the twenty-first annual meeting of the Society to be held at St. Paul, Minnesota, as June 22 to 25, inclusive.

The Meetings Committee has been working on the arrangements for the meeting for some time and prospects are excellent for a most attractive program and a most enjoyable and profitable meeting. A general outline of the program will appear in an early issue of AGRICULTURAL ENGINEERING.

Suggestions for topics and speakers for the program from A.S.A.E. members will be most welcome. They should be sent to Wm. Boss, chairman, Meetings Committee, University Farm, St. Paul, Minn., or to the respective division chairmen, if they pertain to the programs of the division sessions.

New A.S.A.E. Professional Division

THE Council of the American Society of Agricultural Engineers recently approved a petition submitted to it by a group of consulting agricultural engineers in the Society membership for the organization of the "Consulting Engineers Division" of the Society.

It has been recognized for some time that the consulting phases of agricultural engineering have been developing rapidly. The object of the organization of this division, as outlined by the group of consulting agricultural engineers, is (1) to establish and dignify the profession of consulting agricultural engineering and to promote its welfare in every legitimate way possible; (2) to maintain a high professional standard of personal fitness, adequate technical training and wide practical experience so that all admitted to membership may be fully competent to serve as consulting agricultural engineers; (3) to make more widely known the work of the consulting agricultural engineer, and to convince those having agricultural interests that the services performed by the consulting engineer is essential to the conduct of every commercial agricultural enterprise and worthy of adequate compensation, and (4) to establish a code of ethics for agricultural engineers.

The Council of the Society in authorizing the organization of this division felt that it would tend greatly to strengthen the consulting branch of the profession and serve to stimulate its development.

President O. W. Sjogren has appointed Wendell P. Miller, consulting agricultural engineer, Columbus, Ohio, to act as temporary chairman of the new division until the annual meeting in June when formal organization of the division will take place.

Council Meeting at Chicago

A MEETING of the Council of the American Society of Agricultural Engineers was held in Chicago, December 1. The members of the Council present included First Vice-President Theo Brown, Second Vice-President J. L. Strahan, Past-President F. A. Wirt, C. O. Reed and Raymond Olney.

At this meeting the Council decided that the dates of the twenty-first annual meeting to be held at St. Paul, Minnesota, should be June 15 to 18, 1927. (Due to the fact, however, that the First International Congress of Soil Science meets in Washington, D.C., on these dates, and that a number of A.S.A.E. members are scheduled to present papers at that meeting, it is quite possible that the Council will change the dates of the A.S.A.E. meeting to June 22 to 25, inclusive.)

In response to a resolution presented by the North Atlantic Section of the Society the Council took action definitely approving the selection of Washington, D.C., as the place for holding the 1928 annual meeting. A recommendation in the form of a motion, was made to the effect that the Council give serious consideration to a combination annual meeting and boat trip on the Great Lakes in 1929.

The Council considered a proposal presented by the Publications Committee that the Society do not undertake the publication of an agricultural engineering handbook but encourage some publishing house to do so and extend such an organization the privilege of making use of the data which the Society has collected for that purpose. The Council took action authorizing the Publications Committee to make arrangements to have the data published by some reputable publishing house with proper protection of the Society's interests in it.

Following the presentation of a report made by the Committee on the Revision of Agricultural Engineering Classification at the annual business meeting of the Society at Lake Tahoe in June 1926, a motion was made and carried that the subject matter classification presented at that time be referred to the Council with authority to adopt or reject the recommendations of the committee. The Council at its meeting in Chicago took formal action to adopt the subject matter classification as presented. This classification will shortly be available in printed form.

The Secretary made a report of the Society's financial condition and presented a budget for the remainder of the calendar year 1926 which was approved.

Section Meeting Features Reclamation Financing

THE annual meeting of the Pacific Coast Section of the American Society of Agricultural Engineers was held at the Engineers Club in San Francisco on the afternoon and evening of December 11. Forty members and visitors attended the afternoon meeting, with thirty in attendance at the banquet in the evening. Although the agricultural engineering offices of the federal government and the University of California were well represented, registration at the opening of the afternoon session showed that a substantial majority of those present were from the commercial fields.

In the arrangement of the program two general topics were selected for consideration: (1) The financing of western reclamation districts; (2) the field of the consulting agricultural engineer. Owing to the length of the papers presented and the discussions which followed, it was found necessary to postpone the second half of the program for consideration and discussion at a future meeting of the Section. The following program of a papers was presented:

"Financial Problems of California Reclamation Districts"—Wm. Durbrow, president, Irrigation Districts Associations of California; general manager, Glenn-Colusa Irrigation District.

"Methods of Financing Irrigation Districts"—J. L. Lilienthal, vice-president, Freeman Smith and Camp.

"Financial Problems of Delta Reclamation"—J. V. Mendenhall, president, California Delta Farms, Inc., Holland Land Company.

"Meeting the Agricultural Engineering Needs of the Farmer"—L. J. Fletcher, division of agricultural engineering, University of California.

Mr. Durbrow presented a most excellent paper on the subject, assigned to him, which will appear in an early number of AGRICULTURAL ENGINEERING.

In the presentation of his subject on methods of financing irrigation districts, Mr. Lilienthal speaking extemporaneously sounded a warning against the practice of issuing warrants against reclamation bonds referring to several instances where funds had failed to be voted to retire the warrants. As a result of this practice, excessive expenditures in the district were often incurred, discounting of warrants increased interest rates and a general altitude of suspicion was created among bond brokers. Mr. Lilienthal next discussed existing

conditions as regards reclamation district bonds, emphasizing the fact that the general agricultural depression, collapse of several bonding houses dealing in these securities and the failure of a number of western irrigation districts had resulted in a gradual decline in value of reclamation bonds during the past ten years.

Mr. Lilienthal also gave his opinion of why reclamation bonds were not selling readily. These included lack of due consideration of economic and engineering features that had to do with the feasibility of the district or those things within the agricultural engineer's province. He also stressed the point that farmers generally are shouting "I am broke" and banks are taking them seriously and therefore direct their loans to industries claiming prosperity. The question of personal liability rather than blanket liability in district financing was discussed as was also the assessment basis rather than flat rate. The question of using averages in production as a basis of financing rather than the performance of the "below average" where blanket liability prevailed, was discussed.

In discussing the financial problems of the delta reclamation, Mr. Mendenhall outlined in detail the method of the Delta Farms used in the financing of their enterprise. In his discussion the speaker laid particular stress on the importance of segregation of costs and proper bookkeeping methods as a basis in the preparation of an annual budget of expenditures and operation costs. In describing the system of accounting and segregation of costs reference was made to what Mr. Mendenhall called his "bible" in which was itemized the cost of each step in the entire farming operations of the company. This budget prepared in February is readjusted from time to time to meet the varying conditions caused by weather conditions, fluctuating markets, labor conditions or unfavorable crop estimates. In closing his discussion, Mr. Mendenhall referring to the broader phases of reclamation financing warned against the issuing of short term bonds (10 years or less), pointing out that the inability of the land to produce sufficient return in this period to retire the bonds necessitated refunding measures.

Power Take-Off Standards Conference

A FEW representatives of the tractor industry met in Chicago, December 14, under the auspices of the Standards Committee of the American Society of Agricultural Engineers to draft proposed A.S.A.E. standards and recommended practices relative to the power take-off for tractors. This meeting was in response to the urgent needs pointed out by representatives of the tractor industry for standards to avoid the present confusion in the development of the power take-off, which is undoubtedly retarding the development along these lines.

Representatives from five tractor manufacturers, acting as a sub-committee of the general A.S.A.E. Standards Committee, met and drafted standards covering the type and size of power take-off attachments, speed of the power take-off shaft, height of the power take-off shaft from the ground line, location of the power take-off with respect to the point of hitch of the tractor, the power take-off equipment that should be furnished by the tractor manufacturer and the manufacturer of the drawn machine, and recommendations for guarding the power take-off for the safety of the operator.

After the standards and recommended practices which were formulated as a result of this conference are approved by the Standards Committee, they will be submitted to manufacturers of tractors and drawn machines for comments and later submitted to the membership of the Society for adoption.

It was felt by those who attended the conference that the standards are of the utmost significance and will have a very decided effect in stimulating the development of the power take-off and the more extensive application of this principle to farm implements and machines.

Fletcher Joins Caterpillar Organization

ANNOUNCEMENT of the appointment of L. J. Fletcher, professor of agricultural engineering and head of the division at the University of California, as agricultural engineer and supervisor of agricultural sales, is made by the Caterpillar Tractor Company, of San Leandro, California, and Peoria, Illinois. Mr. Fletcher took up his new duties on January 1 with headquarters at the Peoria (Illinois) factory of the company.

L. J. FLETCHER

Leonard J. Fletcher was born in Nebraska and educated in Iowa. His preparatory education was received at Mason City, Iowa. Prior to entering college he was engaged for three years in the retail selling of hardware and implements. In 1915 he graduated from Iowa State College with the degree of bachelor of science in agricultural engineering. During the summer of 1915 he was employed by the Iowa Agricultural Experiment Station on the design and construction of a self-supporting masonry arch roof. He then spent one year as instructor in agricultural engineering at the State College of Washington, where he conducted a special investigation into the cause and remedy of dust explosions in threshers.

In 1916 he went to the University of California as an instructor in agricultural engineering and was successively advanced to assistant professor, associate professor, and full professor of agricultural engineering at that institution; he has been head of the agricultural engineering division since 1920. During his connection with the University of California the division of agricultural engineering has made rapid progress, and is recognized as one of the outstanding departments in the country. During the past year a professional course in agricultural engineering has been inaugurated, and at the present time a new building for the division is being erected at University Farm at Davis.

Mr. Fletcher has taken a prominent part in agricultural engineering development in this country, particularly in the field of farm power and machinery, and is one of the recognized leaders of the profession. Since his election to membership in the American Society of Agricultural Engineers in 1918, he has taken a prominent part in Society activities. He has served in important capacities, including that of vice-president, member of the Council, and as chairman and member of a number of Society committees. In July of last year he was appointed chairman of the College Division. He is at present a representative of the Society on the advisory council appointed by Secretary of Agriculture Jardine in connection with the National Survey of Research in Mechanical Farm Equipment that is being conducted by the Department of Agriculture. He is a member of the joint Committee on Cooperative Relations of the Society and the National Association of Farm Equipment Manufacturers. He is also a director of the Tractor and Implement Club of California.

Mr. Fletcher has also been prominently identified with rural electrification development. When the agricultural and electrical industries in California undertook to conduct a series of investigations to determine the economic use of electricity on the farm, he was made chairman of the California Committee on the Relation of Electricity to Agriculture to direct these studies.

While Mr. Fletcher has been a most active leader in developing agricultural engineering in California, his knowledge and conception of agricultural engineering problems are nationwide in their scope, and he enjoys a distinct national reputation as an agricultural engineer. He goes to his new position especially well equipped to supervise the agricultural sales of Caterpillar tractors and with the best wishes of the entire agricultural engineering profession.

Walker Appointed Chairman College Division

H. B. WALKER, professor of agricultural engineering, Kansas State Agricultural College and a past-president of the American Society of Agricultural Engineers, has been appointed by President O. W. Sjogren to succeed L. J. Fletcher as chairman of the College Division of the Society.

Mr. Walker's activities in the Society as president, member of the Council, the Society's representative on American Engineering Council, a member of the Advisory Committee of the College Division, chairman of the Committee on Cooperative Relations with the National Association of Farm Equipment Manufacturers is a record of outstanding service. He is one of the recognized leaders of the agricultural engineering profession, and the College Division is particularly fortunate in having him as its chairman.

Personals of A.S.A.E. Members

J. B. Davidson, professor of agricultural engineering, Iowa State College, addressed the experiment station division of the American Land Grant College Association on November 6 on the subject, "Agricultural Engineering Developments and Economic Adjustments." On January 27 he will address the meeting of the Iowa Engineering Society at Des Moines on the subject, "The Contribution of Engineering to Agriculture."

Eloise Davison, assistant professor of household administration, Iowa State College, will address the Iowa Engineering Society on the subject of household management at its meeting in Des Moines, January 27.

V. R. Hillman has resigned as assistant professor of agricultural engineering with the engineering experiment station, of Kansas State Agricultural College, to join the agricultural engineering staff at the Virginia Polytechnic Institute. In his new work he will divide his time between resident instruction in farm power and machinery and investigational work in rural electrification.

Arthur Huntington, public relations engineer, Iowa Railway and Light Corporation, delivered an address before a meeting of Iowa chamber of commerce secretaries, at Davenport, October 21, on the subject, "What Iowa Has to Offer for Its Industrial Development." He addressed the Agricultural Commission of the American Bankers Association in Chicago, December 1, on the subject, "The Engineer in Agriculture," and he will address a meeting of the north central division of the U. S. Chamber of Commerce in Chicago, January 20-21, on the subject, "Agricultural Production Cost Figures."

George W. Iverson, advertising manager of Advance-Rumely Thresher Company, has recently been promoted to the position of western sales manager of his company. Mr. Iverson is also chairman of the Farm Power and Machinery Division of the American Society of Agricultural Engineers.

Charles F. Shaw, professor of soil technology, University of California, as chairman of the Committee on Terminology of the American Soil Survey Association, presented a glossary of terms used in soil classification at a recent meeting of the association. This glossary will undoubtedly be adopted by the association as an official dictionary of terms used in soils work.

R. W. Trullinger, Specialist in Agricultural Engineering, U.S.D.A. Office of Experiment Stations, has recently been advanced to "Assistant in Experiment Station Administration (Agricultural Engineer)." The "Agricultural Engineer" in parenthesis denotes that while he will assist in the administration of all experiment station work, he will be especially responsible in both advisory and supervisory capacities for the research work in agricultural engineering at the experiment stations and when making an inspection of an experiment station he will be expected to devote time to the agricultural engineering work.

H. B. White, division of agricultural engineering, University of Minnesota, is joint author with M. G. Jacobson, of Special Bulletin No. 111, "Farm Building Plans," just published by the agricultural extension division of that institution. The bulletin is devoted chiefly to and extensive list of building plans for houses, barns, corn cribs, granaries, garages, hog houses, ice houses, machine sheds, milk houses, poultry houses, etc., prepared by the Division of Agricultural Engineering.

F. A. Wirt, advertising manager of J. I. Case Threshing Machine Company, addressed the annual convention of the National Brotherhood of Threshermen in Chicago, December 1, on the subject, "The Spread of the Combine."

Report of Commissioner of Reclamation

THE twenty-fifth annual report of the Bureau of Reclamation of the U. S. Department of the Interior, for the fiscal year ending June 30, 1926, has recently been submitted to the Secretary Work by the commissioner of reclamation, Dr. Elwood Mead, (Hon. Mem. A.S.A.E.) The report gives a brief resume of income and operating expense of the Bureau of Reclamation for the period of July 1, 1925 to June 30, 1926, payments received from water users, amount appropriated and expended on construction payments by water users, total area on the projects provided with water for irrigation, total area irrigated, total area crop, value of irrigated agricultural products and the total value of crops grown on irrigated land furnished with water from the works of the Bureau of Reclamation. It also includes a record of construction and operation, a discussion of engineering operations and needs and a brief as well as an extended report of individual projects.

What Federal Reclamation Should Include

THE Bureau of Reclamation, U. S. Department of the Interior, has just issued a bulletin, entitled "Federal Reclamation—What It Should Include," by Dr. Elwood Mead (Hon. Mem. A.S.A.E.), commissioner of reclamation. This treatise is similar to the address presented by Dr. Mead before the twentieth annual meeting of the American Society of Agricultural Engineers. It discusses briefly some of the difficulties met by the government and the water users on the federal irrigation projects and outlines a constructive policy for the future. It also contains letters from a number of prominent men who have paid considerable attention to Western reclamation problems, in which they have discussed the subject of reclamation from the standpoint of close personal contact with settlers on the irrigated farm.

C.R.E.A. Publishes Correlation Outline

THE Committee on the Relation of Electricity to Agriculture, in cooperation with the project leaders for the state committees, has prepared and published a correlation outline of investigations on the application of electricity to agriculture. This outline appears in the January 4, 1927, issue (Vol. III, No. 2) of the "C.R.E.A. Bulletin." Copy of this bulletin may be secured by addressing Dr. E. A. White, director of the Committee, 1120 Garland Building, Chicago, Illinois.

According to the classification used in the correlation outline, one hundred investigations and observations on the application of electricity to agriculture are now under way in twenty states.

Agricultural Engineering in Short-Course Program

THE staff of the agricultural engineering division at the University of Minnesota has prepared an interesting program of instruction for the Farmers and Homemakers Week short-course at University Farm, St. Paul, January 17 to 22. Such subjects as drainage, land clearing, gas engine operation, locating farm buildings, mixing and curing concrete, ventilation, cropping newly cleared lands, using electricity on the farm, and a water supply for the farm buildings will be presented in the classes of farmer students.

In addition the program will be featured by a talk by Roy

E. Murphy, of Burlington, Iowa, on how he operates a 200-acre farm without horses. "The Effective Use of Power in Farming" will feature a second talk to be given by Mr. Murphy. The latest developments in farm machinery will be presented by J. B. Torrance of the agricultural engineering staff.

Each day's work will be opened with a conference hour for the discussion of individual problems submitted by farmers attending the course. All members of the agricultural engineering division will be present to give counsel and help.

New A.S.A.E. Members

D. E. Blandy, rural service division, Adirondack Power & Light Corporation, Schenectady, N. Y.

Celia S. Bush, home economist, Estate Stove Company, Hamilton, Ohio.

F. L. Ferguson, drainage director for Ontario, Ontario, Agricultural College, Guelph, Ontario, Canada.

J. de la Fuente, mining engineer and joint manager of Manuel de la Fuente e Hijo, Torreon, Coahuila, Mexico.

R. R. Norris, field manager of sales, Rotary Plow Mfg. Co., San Francisco, California.

L. M. Marble, president, The Marble Laboratory, Canton, Penn.

W. P. Young, W. P. Young & Son, agricultural chemistry and farm machinery, Pottstown, Pa.

Transfer of Grade

R. H. Black, assistant chief marketing specialist, U. S. Department of Agriculture, Minneapolis, Minn.

H. H. Doughty, tractor lubrication engineer, Standard Oil Company, Peoria, Ill.

F. W. Duffee, associate professor of agricultural engineering, University of Wisconsin, Madison, Wisconsin.

J. P. Fairbank, extension specialist in agricultural engineering, University of California, Davis, Cal.

J. F. Goss, assistant professor of agricultural engineering, South Dakota State College, Brookings, S. D.

Frank C. Kingsley, assistant in farm mechanics department, University of Illinois, Urbana, Ill.

C. G. Krieger, Jr., sales and service engineer, H. C. Nash Motor Co., Portsmouth, Va.

G. W. McCuen, professor of agricultural engineering, Ohio State University, Columbus, Ohio.

E. G. McKibben, junior agricultural engineer, University of California, Davis, Cal.

C. R. Olson, consulting agricultural engineer, 909 S. Wabash Ave., Urbana, Ill.

L. G. Samsel, J. I. Case Threshing Machine Co., Racine, Wis.

A. J. Schwantes, assistant professor of agricultural engineering, University of Minnesota, St. Paul, Minn.

B. M. Stahl, instructor The Ohio State University, Columbus, Ohio.

W. H. Willis, engineer, Corpus Christi, Tex.

F. J. Zink, field engineer, Iowa Engineering Experiment Station, Iowa State College, Ames, Iowa.

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the December issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

George Amundson, extension specialist in agricultural engineering, Michigan State College, East Lansing, Michigan.

Roy Bainer, research work in agricultural engineering, Kansas State Agricultural College, Manhattan, Kansas.

C. B. Dempster, supervision of engineering, Dempster Mill Manufacturing Co., Beatrice, Nebraska.

W. J. Dingens, supervising sales and installations of farm lighting and cooking systems, J. B. Colt Co., New York, N. Y.

N. W. Gage, president, Gage Publishing Co., New York, N. Y.

R. R. Parks, instructor in agricultural engineering, University of Missouri, Columbia, Missouri.

L. C. Prickett, rural application engineer, General Electric Co., Schenectady, N. Y.

V. W. Renne, J. B. Colt Co., Chicago, Ill.

G. E. P. Smith, investigation and research, University of Arizona, Tucson, Arizona.

E. J. Solomon, designing threshing machinery, Avery Power Machinery Co., Peoria, Ill.

Transfer of Grade

H. T. Barr, instructor agricultural engineering, University of Arkansas, Fayetteville, Arkansas.

Nils Berglund, teaching farm machinery at Ultuna Lantbruksinstitut, Uppsala, Sweden.

A. T. Holman, extension service, North Carolina State College, Raleigh, N. C.

W. C. Howell, teaching, Mississippi A. & M. College, Agricultural College, Mississippi.

M. M. Jones, teaching farm machinery, University of Missouri, Columbia, Missouri.

H. W. Le Mert, extension, University of Missouri, Columbia, Missouri.

J. W. Sjogren, agricultural engineer, Colorado Agricultural College, Fort Collins, Colorado.

A. T. Upson, promotion of American Lumber Standards, National Lumber Manufacturers Association, Washington, D. C.

Employment Bulletin

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of AGRICULTURAL ENGINEERING. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Non-members as well as members, are privileged to use the "Positions Open" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

Men Available

AGRICULTURAL ENGINEER, married, age 29, 1922 graduate of Iowa State College in agricultural engineering, now assistant engineer in construction department of International Railways of Central America, desires position where permanent residence is possible, preferably experimental or production work, or management of reclamation project or large ranch. Ten years experience in general farming with power equipment, experimental and teaching work, and construction work. Can speak Spanish, also some French and German. MA-130.

AGRICULTURAL ENGINEER available. Seventeen years experience in the designing and manufacture of farm tractors, motor trucks, harvesting machines, and earth-working tools. Sales experience in United States, Canada, England, France, and Italy. Write for interview. MA-132.

AGRICULTURAL ENGINEER, graduate of University of Illinois, nine years teaching experience as assistant professor in one of the largest universities of the central west. Eleven years manufacturing experience with one of the large tractor and farm implement builders. Experienced in production, design, and management. Desires position preferably as extension agricultural engineer or experimental or production manager work. MA-133.

AGRICULTURAL ENGINEER, 1926 graduate from Virginia Polytechnic Institute, desires position in some branch of agricultural engineering, preferably farm power and machinery. MA-136.

AGRICULTURAL ENGINEER, single, age 22, 1926 graduate of Ohio State University, Department of Agricultural Engineering, looking for temporary or permanent work. Particularly interested in rural electrification. Further information furnished upon request. MA-137.

AGRICULTURAL ENGINEER, 1924 graduate of University of Wisconsin, desires permanent connection. Past experience includes tree surgery and tractor motor inspection. Prefers duty on private estate or investigational work. Edwin A. Bier, 515 N. Church St., Rockford, Ill.

Positions Open

WANTED mechanical designer experienced in layout work in connection with tractor design. Location Middle West. PO-121.